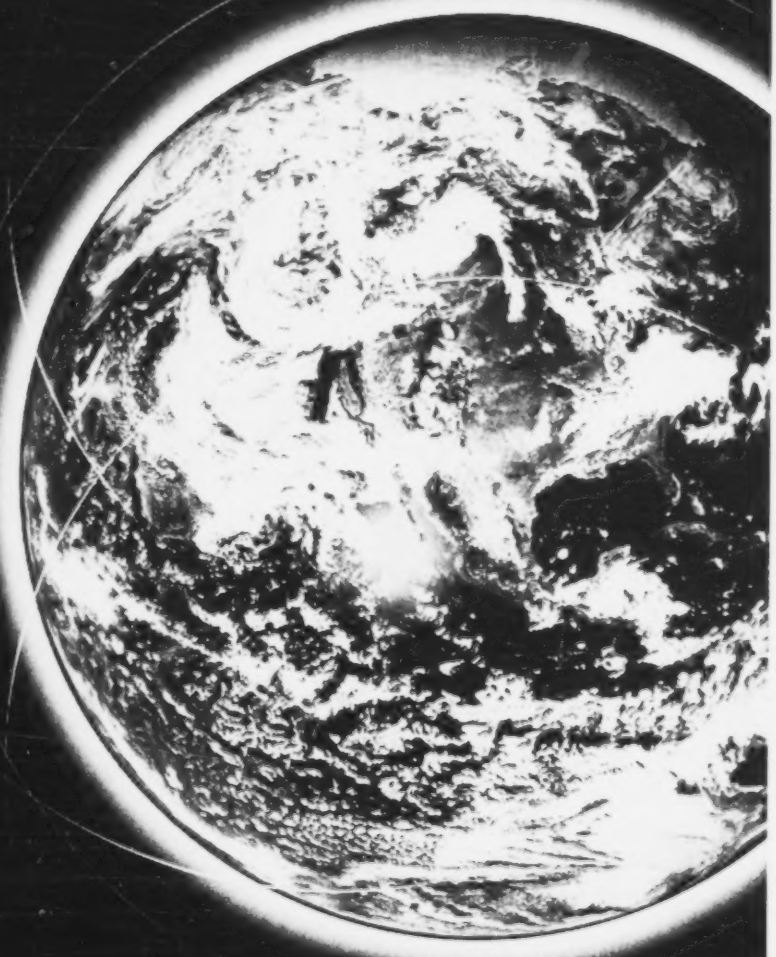
Defence Research and Development Canada | Recherche et développement pour la défense Canada

Protecting Our World in Uncertain Times

ANNUAL REPORT 2003–2004



DEFENCE R&D DÉFENSE

Canada

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Protecting Our World in Uncertain Times
Defence Research & Development Canada
Annual Report 2003-2004

The caption that accompanies the photograph on page 18 should read as follows:

Capability Engineering facilities at DRDC Ottawa

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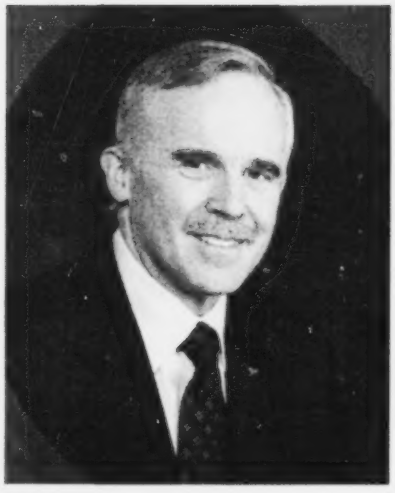
Concept for the cover design by Kathleen Holman of DRDC Atlantic

Message from the Chief Executive Officer

The men and women of the Canadian Forces, and those who support them, serve in a growing number of important operations around the world. In Afghanistan, Bosnia-Herzegovina, Haiti, Africa and the Middle East, Canada is participating in United Nations and North Atlantic Treaty Organization (NATO) operations to combat terrorism, keep the peace and provide humanitarian assistance.



Defence Research and Development Canada (DRDC) continues to provide research and development advice, services and products to the Canadian Forces and its missions. Through our leadership in defence science and technology, we are making a strong contribution to the present and future operational effectiveness of the Forces, thereby impacting the safety of Forces personnel and the continued quality of Canadian defence programs.

In addition, DRDC is becoming more involved in public security for Canadians. We are using our expertise to enhance national capability and capacity to counter and respond to terrorist threats. By working effectively with other government departments and agencies, DRDC is helping to set in place the systems and programs that will provide enhanced safety and security for our citizens and the infrastructure that supports our way of life.

I am very proud of the considerable achievement of the DRDC staff over the past year, a small part of which is reflected in this report. We have advanced the state of military science in several areas and continued to develop our reputation as a research and development agency that delivers products and advice of the best quality. It is the personal commitment and energy of our people that make our agency one of the world's leading-edge defence science organizations.

This annual report is our fourth as a special operating agency. It highlights some of our work for both defence and public security, and explains how we are helping to protect our country and our world in these challenging times. I am sure you will find it informative.

L.J. Leggat

L.J. Leggat
Chief Executive Officer, Defence R&D Canada

Overview of Defence Research and Development Canada

Defence Research and Development Canada (DRDC) is Canada's leader in science and technology for national defence and public security. DRDC operates six research centres across Canada, each with a unique combination of expertise and facilities to carry out world-class research and development. We are well placed to offer innovative research and development across a broad spectrum of defence technologies well into the future. (See Table 1 at the end of this report for more information about our centres.)

Our Mission

As an agency of the Department of National Defence, DRDC's mission is to ensure that the Canadian Forces are technologically prepared and operationally relevant. We do this in the following ways:

- Provide expert science and technology advice to the Canadian Forces and the Department of National Defence;
- Conduct research, development and analysis to contribute to new and improved defence capabilities;
- Anticipate and advise on future science and technology trends, as well as threats and opportunities;
- Engage industrial, academic and international partners in generating and commercializing technology; and
- Provide science and technology for external customers to enhance defence science and technology capacity.

Our Vision

DRDC's vision is to be known worldwide as the best in science and technology for defence and security.

Our Values

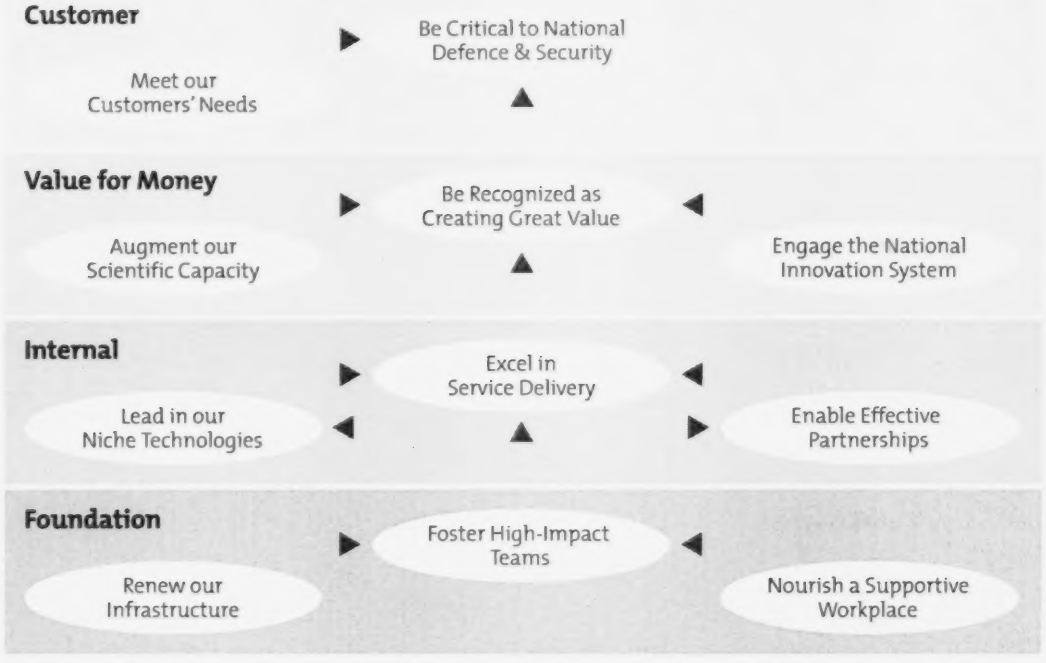
DRDC's values define how we accomplish our mission and maintain excellence in science:

- **Commitment**: We demonstrate dedication and pride in working towards our vision.
- **Client Focus**: We bring excellence to clients, both internal and external, by focusing efforts on discovering and meeting their needs.
- **Creativity and Innovation**: We generate innovative solutions, approaches, products and services that improve the status quo.
- **Leadership**: We actively and enthusiastically seek to exert influence and originate action to achieve our goals.
- **Professionalism and Integrity**: We focus our effort on achieving quality results, and we behave in an honest, ethical manner, dealing with others respectfully and fairly.
- **Trust and Respect**: We are open, honest and responsible in our relationships and we recognize and value the contributions of others.
- **Teamwork**: We demonstrate effective interpersonal skills, and work cooperatively and productively within and across DRDC to achieve common goals.

Our Strategy

DRDC's strategy focusses on a small number of objectives, which are shown in the strategy map below. These are the areas in which we must excel to realize our mission and achieve our vision. The objectives are grouped into the four perspectives of the strategy map: *Customer, Value for Money, Internal* and *Foundation*.

Defence Research and Development Canada's ***Strategy Map***



THE ARCHITECTURE OF THE REPORT

The four perspectives of our strategy map provide the structure for this report, which highlights our accomplishments in fiscal year 2003–2004 in support of the realization of our objectives:

- **Customer**: The chapter entitled *Contributing to National Defence and Public Security* highlights our contributions to defence capability and our support of the public security needs of Canada.
- **Value for Money**: The next chapter, *Providing Value for Money*, describes the augmentation of our scientific and technological capacity through international and national collaborations and through the work we do for external clients.
- **Foundation**: The following chapter, *Strengthening Our Foundation*, focusses on enhancing the productivity and creativity of our people, on renewing our infrastructure and on protecting our environment.
- **Internal**: The last chapter, *Promoting Operational Excellence*, shows that we are an organization that promotes excellence, that engages our customers, and that continuously improves our internal processes.

This report concludes with our *Financial Statement*, in which we present our revenues and expenditures for fiscal year 2003–2004, and the *Tables*, which provide additional information about our centres and our program.

Contributing to National Defence and Public Security

As an essential element of the defence team and through broad engagement of the Department of National Defence and the national security community, DRDC is ideally positioned to define and advance science and technology issues in the areas of defence and security. We are recognized by the Canadian Forces as a key contributor to defence capability. We are also developing the needed capacity to provide the science and technology underpinnings for Canada's national security needs.

This chapter highlights the activities that contribute to military operations, enable future relevant forces, enhance public security, protect and sustain Canadian Forces personnel, shape strategic direction and optimize resource utilization.

Supporting Military Operations

During the last year, products of the DRDC program have provided improved operational capability to the Canadian Forces. Some of the more interesting successes are highlighted below.

FERRETING OUT SNIPER THREATS

Recently deployed in Afghanistan, the FERRET provides the Canadian Forces with better protection against snipers. The FERRET is a passive acoustic system for the detection and localization of small-arms fire at long ranges. The system is composed of a three-dimensional microphone array mounted on the rear of the turret of the Coyote light armoured reconnaissance vehicle. The system processes the sound signals and shows the results on a hand-held terminal by means of a graphical and numerical display.

IMPROVED LANDMINE DETECTION

Also successfully deployed in Afghanistan was the Improved Landmine Detection System (ILDS), the only fielded, vehicle-mounted, multi-sensor mine detection system in the world. The ILDS comprises a Protection Vehicle, a Remote Detection Vehicle and a Control Vehicle Station. The Protection Vehicle removes all obstructions and other surface threats from the path of the Remote Detection Vehicle, which uses its sensors to locate mines. The Control Vehicle Station, installed on a personnel carrier, houses the sensory integration software and the remote control equipment that drives and controls the two other vehicles. Altogether, these three vehicles make the detection of landmines a much easier task and provide the Canadian Forces with unparalleled protection against them.

The FERRET microphone array mounted on the Coyote

FORCE PROTECTION AGAINST NAVAL TERRORISM

The threat of terrorist attacks against our forces and naval assets operating abroad is very real. To provide an analysis of the effectiveness of the measures we use to counter terrorist attacks against our ships, DRDC developed new realistic engagement models and conducted many scenario-based studies. This analysis was backed by weapon performance and vulnerability data generated by our research centres.

The analysis resulted in over 30 recommendations to improve self-defence effectiveness and to mitigate risks. The new doctrine and tactics for force protection procedures for deployed ships has had an immediate impact on Navy operations, and has led to better recognition of our capability deficiencies. It also led to the establishment of a new international collaborative study on Maritime Force Protection, which Canada is leading.

DIVING IN GREATER SAFETY

The level of safety built into diving equipment can make a big difference for divers. DRDC introduced into service within the Canadian Forces, the Canadian Underwater Mine-countermeasures Apparatus (CUMA), enhanced with the Auxiliary Gas Supply System and Canadian Clearance Diving Apparatus rebreathers. Specially designed for use in mined waters, CUMA gear differs from regular scuba gear in that it contains no metallic features that may trigger magnetic mines, and uses a process called rebreathing that recycles the diver's breathing gas, eliminating bubbles that can trigger acoustic mines.

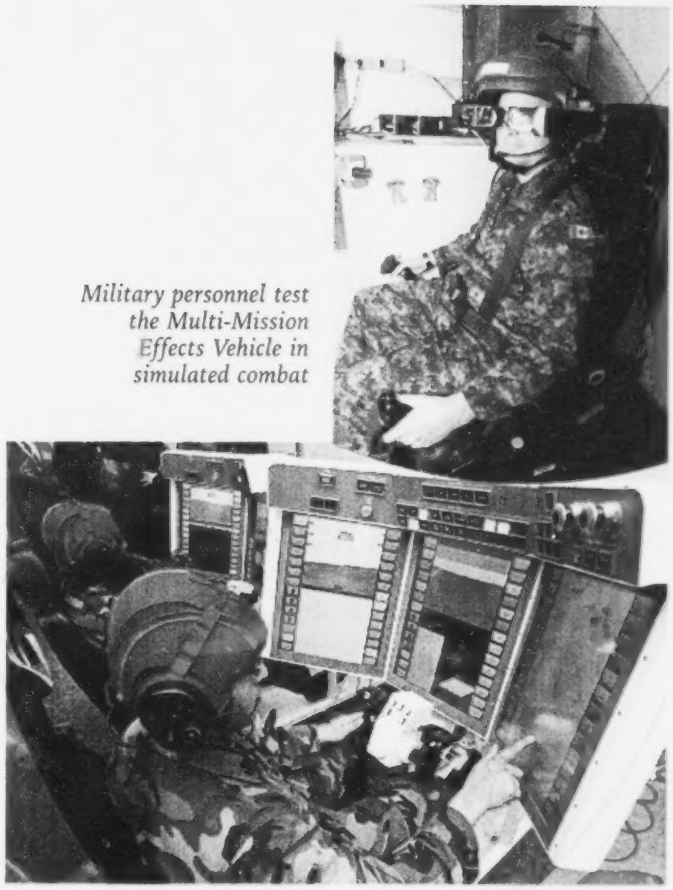
A diver being helped into his CUMA gear

IMPROVED SITUATIONAL AWARENESS ABOARD CANADIAN VESSELS

Timely and accurate situational awareness is crucial to the safety and effectiveness of Canadian vessels operating abroad and in Canadian waters. Command and control systems, either shore-based or ship-based, provide this situational awareness through the confluence of information

from a large number of sources. These sources can include tactical units at sea, allied navies, intelligence organizations, other government departments and open databases. The Recognized Maritime Picture is the top-level view of the various activities taking place in a maritime area of interest. It is constructed through the integration and analysis of all relevant information and the assembly of this information into a comprehensive depiction of the significant activities.

Working closely with the Navy, DRDC conducted research that identified a number of specific improvements that could be made to the command and control systems. We created new software algorithms, re-configured existing software tools, and developed training and operating procedures that were successfully implemented on board Canadian naval ships. Demonstrations of these improvements have so far indicated a significant increase in capability and situational awareness. We also carried out further enhancements to the system to broaden its capabilities. Ultimately, the Canadian Forces will have a better and more timely Recognized Maritime Picture, with automated tools for directing their attention to the most pertinent parts of that picture.



Military personnel test the Multi-Mission Effects Vehicle in simulated combat

Enabling Future Relevant Forces

To operate successfully in a multitude of theatres, the Canadian Forces need to remain responsive to the changing needs of Canada and its allies. The main focus of DRDC's work impacts the creation of capable, modern and sustainable forces that are relevant to a diverse range of operational demands.

FUTURISTIC COMBAT SIMULATION

Canadian and American crews put to the test our Multi-Mission Effects Vehicle (MMEV) in a simulated future combat experiment. Featuring control of weapons for direct fire, beyond-line-of-sight fire, and air defence, the MMEV allowed crews to operate their own and each other's equipment supported by Canadian tactical aviation simulators.

Using a private Internet-like network, the MMEV is able to remotely identify and engage targets using sensor information provided by Canadian and American unmanned air and ground vehicles.

"It was as if I had been transported to the 24th century. I sat in a Multi-Mission Effects Vehicle with helmet-mounted through-the-hull visual and situation awareness displays, and executed commands by talking to a computer to engage an enemy in cooperation with U.S. Army armed robots and a Canadian helicopter."

—SENIOR CANADIAN ARMY OFFICER

Information such as the position of friendly and enemy forces and their movement is communicated to the crew. The result is the tactical advantage of increased situational awareness, allowing crews to better anticipate next moves.

The MMEV concept was explored in simulation experiments that featured interconnected futuristic joint and combined weapon systems simulators. The experiments examined crew workload, training, skill retention, future Army organization development, doctrine development and interoperability with Canadian aviation and U.S. Army future forces. Results from this experiment will help to improve Army interoperability and assess the merits of future Canadian and American technologies in a cooperative fashion. The virtual vehicles are expected to become a reality by 2015.

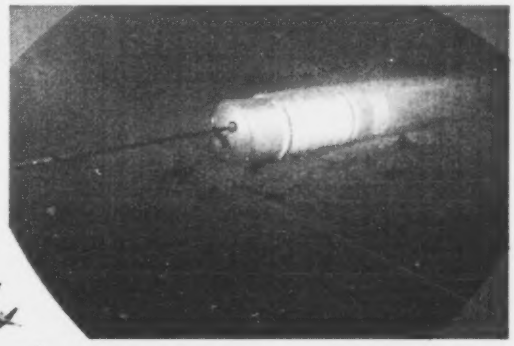
By incorporating a wide variety of sensors that can be used in various ways, the Stealth Buoy can distinguish between different propeller sounds to detect the presence of large and small boats and possibly to recognize specific kinds of craft.

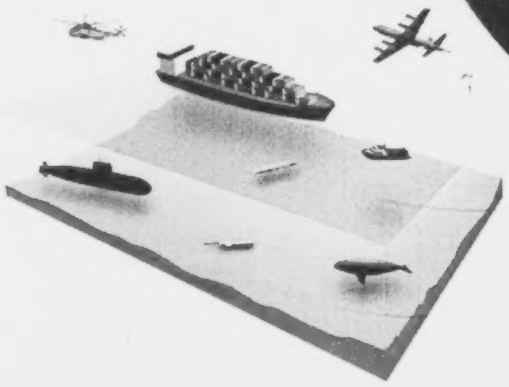
The Stealth Buoy could also be used to track drug boats, and to observe smuggling or illegal activities, including terrorism. This type of application could help to secure the ocean approaches to Canada. The work has attracted considerable interest from naval research organizations in the United States.

In addition, the Stealth Buoy can be equipped with sensors that could measure water temperature and salinity, track pollution and monitor the migration of animals such as whales and dolphins.

LYING IN WAIT

One of DRDC's most exciting developments in underwater warfare is the prototype of a new generation of sonobuoys that are able to hide on the ocean floor. Designed to lie on the bottom in coastal waters until some event causes it to rise to the surface, the Stealth Buoy uses the Global Positioning System to calculate its location on the surface of the earth and the Iridium satellite system to transmit data.





The Stealth Buoy lies in wait until triggered to rise

VIRTUAL NAVAL COMMAND AND CONTROL

The ability to test and evaluate new system concepts and tactics before incurring the expense of implementing them offers tremendous saving of cost and time. To this end, DRDC collaborated in developing a virtual maritime combat suite for use in battle experiments. We modified and added functions to a modelling framework developed by Australia's Defence Science and Technology Organisation (DSTO). The result was a basic virtual Canadian patrol frigate that has been used successfully in national and international computer- and network-based experiments.

As the functional capability of the virtual environment expands, we plan to conduct progressively more ambitious experiments. Eventually we will be able to realistically simulate the capabilities of all of the sensor and the command and control systems of both current and future Canadian naval platforms.

CLEAR VISION IN POOR WEATHER CONDITIONS

The ability to see clearly in poor weather conditions can make the difference between success and failure in search and rescue operations. ELVISS, the Enhanced Low Light Visible and Infrared Surveillance System, can provide this ability.

To put ELVISS to the test, DRDC conducted simulated search and rescue operations from a helicopter over land and in water. ELVISS brings together a powerful laser illuminator and an image intensifier with a thermal imaging system. The result is an integrated instrument tailored to significantly improve surveillance in poor visibility. ELVISS reduces the effects of fog and precipitation, allowing for clear images of objects that would otherwise be totally obscured using conventional viewing systems.

ELVISS being tested on board a helicopter

Searching for radioactivity on the ground and from the air

Enhancing Public Security

In the current global environment, no nation can afford to be complacent about public security. Canada has placed a high priority on establishing a comprehensive program for public safety and emergency preparedness. DRDC has contributed in several ways to supporting the Government's goals in this area by initiating programs to ensure the safety of Canadians.

ENHANCING RESPONSE TO CBRN THREATS

Through the CBRN Research and Technology Initiative (CRTI), DRDC continues to lead the Canadian science and technology community in an effort to enhance the capability and capacity to counter CBRN (chemical, biological, radiological and nuclear) terrorist threats. Using a collaborative, knowledge-based approach, the CRTI brings together federal science departments and agencies, industry and academia, along with national security and intelligence communities, to assess risk and identify gaps.

The CRTI, which is funded by the Public Security and Anti-Terrorism (PSAT) initiative, has allowed us to make significant contributions to public security in Canada. Since the creation of the initiative in 2002, two rounds of project review and selection have yielded 41 projects, for an investment total of $74.8 million. Many of those projects selected in 2002-2003 have already begun to produce results. For example, McFadden Technologies' mobile radiation surveillance network and Med-Eng Systems' CBRN Blast Protective Helmet are just two of the technologies that have been demonstrated to the first responder community.

CRTI publishes an annual report that highlights these and other outcomes. It can be found at the CRTI web site: www.crti.drdc-rddc.gc.ca.

RADIOACTIVE MATERIAL—HANDLE WITH CARE

In an event led by the CRTI, DRDC joined expert technical teams from Health Canada, Natural Resources Canada, the Canadian Nuclear Safety Commission and Atomic Energy of Canada Limited in a field exercise involving the handling of radioactive material. The exercise provided an opportunity to observe the teams responding to a situation involving unknown sources of radioactive materials. The teams were presented with a "real-life" crisis scenario and were asked to locate, identify, characterize and secure all sources of radioactive and contaminated materials. They also used a specially equipped helicopter to detect radioactive sources from the air and pinpoint their locations on the ground.

"We wanted to see exactly how prepared we are and how we would respond if a terrorist attack involving radioactive materials were to occur today. Training exercises like this help us strengthen our skills, improve our procedures and identify any vulnerability to ensure that we are well prepared and confident in our abilities in the event of a real crisis situation. In this instance, the exercise was an unqualified success."

—Ted Sykes, Portfolio Manager of CRTI's Radiological-Nuclear Laboratory Cluster

Counter-terrorism live-agent training

COLLABORATING FOR PUBLIC SECURITY

In June 2003, DRDC initiated the Public Security Technical Program (PSTP), which aims to develop a coordinated program to enhance collaboration across government and to deliver science and technology solutions across many dimensions of public security. We plan to do this by focussing on four primary mission areas:

(1) protection against chemical, biological, radiological, nuclear and explosive threats;

(2) critical infrastructure protection;

(3) disruption and interdiction; and

(4) systems integration, standards and analysis.

The PSTP embraces a two-pronged approach, with a Canadian program that includes many federal government departments and agencies, and a Canada/United States program, which engages the U.S. Department of Homeland Security. The goal of the PSTP is to integrate ongoing and future collaboration into a single, overarching bi-national strategy to ensure efficient and effective use of national resources.

We have also continued to develop and strengthen our linkages with other government departments and agencies involved in the protection of critical infrastructure. We have created strong ties with the Communications Security Establishment (CSE) and with Public Safety and Emergency Preparedness Canada, among others. With CSE, we have formed a community of practice dealing with the important topic of security of wireless networks. We are also establishing relationships with the National Institute of Standards and Technology in the United States in matters related to strong authentication and biometrics. This is an increasingly important area of research because of the heightened interest in border management.

COUNTERING TERRORISM

In 2002, DRDC established the Counter-Terrorism Technology Centre (CTTC) under the PSAT initiative. Through the CTTC, we provide live-agent training for the Canadian Forces, first responders and international organizations. Other activities included expanding our test and evaluation capabilities to support public security, and providing forensic support to domestic responders to a chemical, biological, radiological or nuclear incident.

In its first year of operation, the CTTC offered extensive training to 16 groups from 12 countries. Instruction included the detection, identification, handling and decontamination of live agents.

SENSING DANGER FROM A DISTANCE

DRDC places considerable emphasis on creating new technological tools to cope with the growing threat of terrorism. Responding to a request from the Canadian Forces, we developed the Multi-Agent Tactical Sentry, a robotic system composed of state-of-the-art nuclear, biological and chemical sensors. The initial system includes a ground control station, a robotic platform, a sensor suite, and the supporting infrastructure and logistic elements. Future systems will also include biological agent detectors, providing the Forces with an unequalled detection capability.

LENDING A HAND IN THE SARS OUTBREAK

In 2003, DRDC helped the City of Toronto to deal with the outbreak of Severe Acute Respiratory Syndrome (SARS). Responding to a request from Health Canada's National Microbiology Laboratory, our experts carried out environmental air sampling at Toronto hospitals, where many SARS victims had contracted the disease.

DRDC's unique capability and expertise in biological aerosol collection and detection stems from our long-standing research and development programs in these areas. The technology used to conduct the sampling was originally developed for military use. This effort underlines its important civil applications.

DRDC scientists conduct environmental air sampling during the SARS crisis

Protecting and Sustaining Canadian Forces Personnel

DRDC makes significant contributions to protecting and sustaining the members of the Canadian Forces through research into the areas of human performance, medical countermeasures and protective clothing. We continue to make strong efforts to provide the Forces with tools that provide the most protection, durability and effectiveness.

BRINGING THE BREATH OF LIFE TO OUR SOLDIERS

Bottled oxygen in civil settings is ubiquitous and cheap. However, in military operations, oxygen used for medical purposes is expensive, cumbersome and potentially dangerous. DRDC entered into an agreement with the U.S. military and the University of Toronto Health Sciences Network to develop a Highly Mobile Oxygen Supplementation System (HMOSS). The objective of the HMOSS is to improve the efficiency of systems that deliver oxygen to the soldier in order to enhance treatment of the injured solder in the field. This technology has significant military application, such as the delivery of emergency medical oxygen in remote deployments, medical air evacuation, high-altitude protection and acclimatization, search and rescue operations, and the treatment for the inhalation of toxic agents.

CONSERVING HEARING

Many of our Canadian Forces personnel, engaged in a wide variety of military trades, are susceptible to noise-induced hearing loss.

To investigate the prevalence of this hearing loss and to evaluate the risk factors that may contribute to its development, DRDC created a database of audiograms from volunteers on Canadian Forces bases in Ontario and Nova Scotia. The information collected was related to primary trade, age, gender, years in trade, hearing conservation practices, health history, and other risk factors known to affect hearing.

We also conducted assessments of noise exposure for selected trades using noise dosimetry measurements. With this information, we will be able to create profiles of the development of hearing loss in a variety of air, sea and land trades. This, in turn, will increase awareness of the risk factors associated with the development of hearing loss and will facilitate the creation of intervention strategies to minimize its occurrence.

CHEWING GUM TO STAY AWAKE

The nature of military operations at times requires Canadian Forces members to stay awake and alert for extended periods of time. Through DRDC's research in the area of ergogenic aids, we have developed a caffeinated chewing gum that will help eliminate the symptoms of fatigue.

Each stick of gum contains about the same amount of caffeine as a small cup of coffee. The tissue of the mouth absorbs the caffeine, which is transferred directly into the blood stream. It takes about 45 minutes before peak effects are observed when caffeine is taken by drinking coffee, compared to 10 minutes with the gum. During field trials, some participants were given six sticks of gum throughout the second night of sleep deprivation. Those who chewed the caffeinated gum outperformed their colleagues who had been given a placebo.

A soldier with caffeinated chewing gum

"The testing was done to see if ordinary chewing gum laced with caffeine would have a positive effect on the vigilance of the subjects during a 54-hour period of sustained operations involving only three hours of sleep."

—Tom McLellan, Senior Scientist, Operational Medicine

BETTER CARE FOR FIELD CASUALTIES

Through the development of a unique blood pressure monitor that is resistant to intense noise and vibration interferences, DRDC provided Canadian Forces personnel in the field with the ability to better manage combat casualties and improve medical care.

Unlike other blood pressure monitors, which are not very effective in ambulances and rescue helicopters, our blood pressure monitor measures both blood pressure and heart rate well under adverse conditions. This results in faster diagnosis and treatment of injuries, saving precious time and potentially saving lives.

VIEWING INTERNAL INJURIES

Internal injury is common with blunt trauma in military operations. The ability to view these injuries is critical for accurate detection, diagnosis and monitoring. DRDC developed a compact, field-deployable, three-dimensional (3-D) ultrasound imaging system for front-line casualty care that will deliver a new dimension of capability to Canadian Forces medics and surgeons.

While current 3-D systems are bulky and heavy, making them impractical for field deployments, our system is compact, light and easily portable. It also offers a unique feature for detecting internal organs in motion, such as a pumping heart.

EQUIPPING THE FUTURE SOLDIER

In its fourth year of activity, the Soldier Information Requirements (SIREQ) project focussed on the impact of new technologies—such as computers, radios, night vision devices and displays—on the coordination and efficiency of groups of up to 30 soldiers. The project also provided major lessons on how the coordination of soldiers' activities can be improved using these new technologies. With the lessons learned to date, DRDC was able to provide advice to the Canadian Forces that resulted in the rapid procurement of equipment for current operations. We also captured the interest of allied armies, and we are currently developing mechanisms to share the results and benefits from related research programs.

SIREQ supports the Integrated Soldier System Platform acquisition project, the objective of which is to acquire clothing and equipment to enhance the performance of the future soldier. We plan to complete SIREQ in 2005, after conducting about 60 studies.

A Canadian soldier during a SIREQ experiment

The Body Scanning System (BOSS)

"YES, IT DOES COME IN YOUR SIZE"

Members of the Canadian Forces can now step forward in sartorial elegance. With the help of the Body Scanning System (BOSS), they are able to determine the best garment size to fit their body and find out whether the required item is in stock.

The BOSS is a digital sizing system that calculates 37 different measurements of the human body. Using sizing rules specified by clothing designers, the software recommends the correct size of clothing and equipment for the person being scanned.

The system is currently in place at CFB (Canadian Forces Base) Trenton and CFB Esquimalt. It will be rolled out to all major bases across Canada over the next two years. The BOSS has given the Forces better sizing data, which should allow it to reduce inventory of the work sizes, saving not only on stock itself but also on the warehousing of that stock. It will also help the military determine and track changes to the sizing profile of its members.

"The system will tell the subject being measured if the size exists somewhere in the system, even if it isn't available on the shelf of the base's warehouse. If they take a particular size in a combat shirt and pant and they go to the store and can't find it on the shelf there, it doesn't matter, because they know it exists within the system and they can order it. In some cases people are having special sizes made when we don't believe they actually need it and they could be fitted with the sizes that are there."

—Judith Spanglett, Section Head, Canadian Forces Operational Protective Equipment and Clothing

MINIMIZING ACCIDENTS

The most unpredictable factor in the occurrence of accidents is human error. To examine this phenomenon, DRDC developed the Systematic Error and Risk Analysis (SERA), which identifies the human factor causes of unsafe acts and conditions that result in accidents and incidents.

Currently in use within our human factors accident investigation team, SERA can be used in assessing and improving the safety of air operations. SERA allows investigators to work backward from an accident, through a five-step process that determines the perceptions, goals and actions of those involved in an accident. SERA will make the gathering of human factors data more reliable and timely, thereby improving the dependability of the human factors database from which better interventions can be devised.

Shaping Strategic Direction

DRDC contributes to strengthening the Canadian Forces by conducting reviews and analyses, by generating concepts that shape the future direction of the Forces and influence decision-making, and by developing technologies and tools that facilitate planning processes.

PREDICTING FUTURE CAPABILITIES

To generate discussion among members of the Defence Management Committee as they develop long-term defence strategy, DRDC conducted a strategic analysis of the future security environment. Entitled *Future Security Environment 2025*, the analysis examined geopolitical, economic, social, military, environmental and global health trends, and developed an understanding of how the security environment over the next two decades may unfold. It should also become the point of departure for ongoing discussions among the various force development staffs as they determine the capabilities the Forces will need in the future, given the challenges of the years ahead.

IMPROVING WELL-BEING

DRDC contributed to the improvement of the well-being of the Canadian Forces through strategic studies of future human resources challenges. This work included analysis of the impacts of higher workload, deployment frequency and time away from loved ones.

We also conducted an analysis of the impact of decisions, for example the Force Reduction Program and the Strategic Intake Plan, on the current and forecast demographics of the Canadian Forces. The study identified many challenges, such as succession planning issues and the ability to meet the Trained Effective Strength targets.

Senior military officials will use the findings of both projects to guide policy development and improve decision-making.

FACILITATING MILITARY PLANNING

DRDC entered into a partnership with the Air Force, the Joint Staff and the Canadian Forces Experimentation Centre to focus on facilitating planning and decision-making in the Forces. The Collaborative Operations Planning System (COPlanS) is an integrated, flexible suite of planning, decision-aid and workflow management tools to support the Operational Planning Process (OPP).

"This type of project is very challenging and requires a collaborative teamwork approach. We are working to provide a solution that really supports the automation of the military planning process. This new system is aiming to make life easier for everyone."

—Adel Guitouni, COPlanS Project Manager

The system prototype explored the ability to provide a collaborative environment for planning military operations while integrating risk and decision analysis methodologies. COPlanS will offer a wide range of tools such as mission analysis, course of action development and analysis, multiple criteria decision analysis, risk management, cost and readiness estimators, and OPP profiling. COPlanS will help automate the generation of messages and briefs and the dissemination of information across an organization, allowing for synchronized services.

PLANNING IN A COALITION ENVIRONMENT

Nations rarely conduct military operations in isolation from their international partners. One of the most crucial issues facing allied forces is working together effectively in coalition operations. Rapidly changing technologies and increasingly complex operational environments have posed significant challenges for coalition warfare, increasing the risk of miscommunication, inefficiency, rifts and, possibly, failure. The third multinational experiment on coalition Effects-Based Planning (EBP) examined how this emerging joint concept of improved planning for military operations can work in a coalition environment.

The Coalition Joint Force Headquarters, which included members of the Canadian Forces, some of DRDC's scientists, and Foreign Affairs Canada, explored the EBP process during a two-week multi-national experiment. On behalf of the coalition, the Canadian team led the evaluation of EBP technology requirements, of knowledge management implications, and assessments of a commander's intent. The event contributed significantly to developing a Canadian effects-based approach and to improved interoperability with our allies.

RESPONDING TO JIHADIST THREATS

One of the principal threats to Canada and its allies in the "War on Terror" is jihadism. To anticipate where coalition military efforts may be directed and to identify threats to deployed forces and Canadian and allied interests, we compiled *The Compendium of Global Jihadism*. This document examined the continuing threat posed by these extremists. It explored the nature and extent of the activities of the global jihadist network and the ways its leadership, organization, operations and tactics have adjusted to the loss of its major operating and training bases in Afghanistan. The compendium also analyzed how governments are responding to the jihadist threat.

Optimizing Resource Utilization

To achieve the best strategic balance of investment in our people, equipment and facilities, we must ensure that we are allocating our resources to the areas of highest need and that we are spending assigned resources in an efficient manner. Following are some of our activities that are aimed at ensuring the best utilization of Canadian Forces, departmental and DRDC resources.

"CapDEM will enable decision-makers to manage the amount of information—the right information at the right time—to make the right decisions. CapDEM will forever change what we do and, by the power of connection, what is done in the field."

—Major-General Doug Dempster,
Director General Strategic Planning

IMPROVING DEFENCE ACQUISITION THROUGH CAPABILITY ENGINEERING

With the emergence of network-centric warfare, implementing well-integrated systems is becoming essential for modern military operations. Given the current constraints of the Defence acquisition process, it has been a challenge to determine the best way to equip and prepare the Canadian Forces for the variety of missions to which they must respond. To address this issue, the Department of National Defence asked DRDC in January 2003 to define, demonstrate and validate a new concept called Capability Engineering to support capability-based planning and management. Our response, the Collaborative Capability Definition, Engineering and Management (CapDEM) project, aims to provide a common planning, program execution, decision-supporting process and environment to assist senior defence decision-makers and program managers in the development of capabilities. Military capability is generated when plans, people and equipment are combined to achieve military goals.

Capability-based planning is the process of determining the right blend of plans, people, equipment and activity to optimize the capacity of the Canadian Forces to fill its assigned roles.

The CapDEM project has made excellent progress in its first full year of operation. The project staff completed acquisition, set-up and training activities for the establishment of a Capability Engineering Environment (CEE). This Environment consists of a networked suite of tools that will help scientists, engineers and managers, spread over many geographic locations, to collaborate and exchange data. As an extension of the CEE, Capability Engineering meeting facilities were created at two of our research centres. Within the CapDEM team, we initiated three integrated sub-teams to define the capability engineering process and to explore how synthetic environments and a collaborative approach can be used to support it. In collaboration with stakeholders, we will apply the concept to three cases in order to assess the viability and impact of Capability Engineering on existing business processes and organizations.

Through the extensive use of modelling and simulation, collaborative systems-engineering tools, and a process that links capability-based planning to capability management, CapDEM will provide decision-makers at all levels with increased awareness of options for capability acquisition and delivery.

Capability Engineering facilities at DRDC Valcartier

"TAMSS will provide the means to demonstrate acquisition reforms through crew-in-the-loop distributed modelling and simulation."

—Patrice Belanger, TAMSS Project Director

The Tactical Aviation Mission System Simulation (TAMSS) environment

WELL-FOUNDED ACQUISITION DECISIONS

The ability to effectively and accurately determine acquisition requirements can result in savings of time and money. During the past year, DRDC handed over to the Air Force the Tactical Aviation Mission System Simulation (TAMSS), a synthetic battlefield environment that allows aircrews to determine helicopter requirements. Pilots can experience and test modifications to virtual aircraft subsystems before changes are made to the real vehicle.

TAMSS combines technology with human-centred design to provide an advanced capability to make and support acquisition decisions. Its synthetic environment minimizes risk and encourages new development.

REPLACING SEARCH AND RESCUE AIRCRAFT

Canada's area of responsibility for search and rescue is a staggering 18 million square kilometres. The Canadian Forces have the lead role in providing timely aeronautical response to search and rescue incidents within this vast region, using a combination of fixed-wing aircraft and helicopters.

Having recently replaced search and rescue helicopters with the new CH-149 Cormorants, the Forces' efforts turned to replacing the aging fleets of CC-130 Hercules and CC-115 Buffalo that currently serve as the primary fixed-wing search and rescue (FWSAR) aircraft.

DRDC provided analytical support to the Air Force as it developed a statement of operational requirements (SOR) for replacement of the FWSAR aircraft. The SOR represents an important preliminary step in a process that will culminate in the eventual acquisition of a new aircraft fleet. It also sets the standards against which all competitors in the replacement process will be measured.

SIMULATING REPLENISHMENT AT SEA

To help determine optimal locations of supply points during ship design, DRDC completed software components and integration on a workstation that simulates replenishment at sea. The simulation models the relative phasing of motions of two ships moving at steady speed and heading through a seaway. It can also assist with analyzing personnel requirements for replenishment-at-sea operations, which currently call for significant crew resources.

Providing **Value** for **Money**

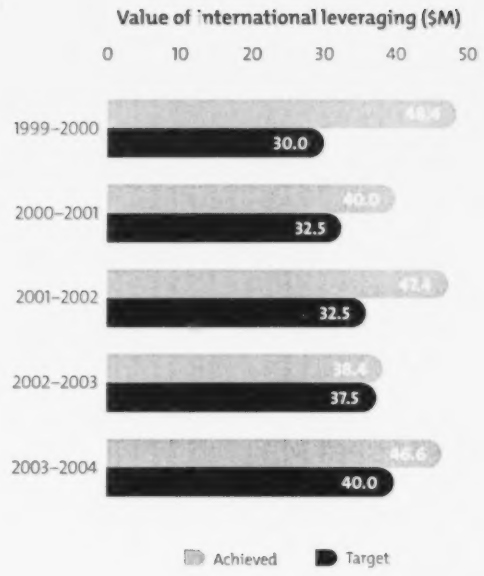
DRDC creates value through an in-depth understanding of the businesses of defence and public security and by providing the most cost-effective scientific and technological solutions to the challenges faced by our customers and stakeholders.

In this chapter we highlight our collaborations with international and national partners. We also show how we are able to augment our capacity for science and technology by offering our services to organizations outside of the Department of National Defence.

Collaborating with Our Allies

Collaborating with other nations has many benefits. We solidify relationships with our allies and benefit from joint research, thereby obtaining more value through leveraging financial and human resources.

DRDC's goal is to leverage a value of about $40 million each year through our international collaborations. This is a difficult value to determine, as many of our international agreements do not specify the financial cost of the effort expended. We therefore estimate the value of the collaborations based on an expected cost to acquire similar value through research contracts. We approximate the value of our international collaboration in fiscal year 2003–2004 to be $46.6 million. The chart on the right shows a five-year history of the value of our leveraging from international collaborations.



DRDC is currently developing a strategy to maximize the benefits of international collaboration. The first step has been to establish a database of our existing and planned collaborations. Using this database, we are analyzing the value we realize for the effort we devote to each collaborative activity. This should allow us to make more strategic decisions about which activities to pursue.

Our collaborations are carried out with allied countries under a number of different international agreements, most notably The Technical Cooperation Program (TTCP) and the North Atlantic Treaty Organization (NATO) Research and Technology Organization (RTO). (For more information on these organizations, visit their web sites at www.dtic.mil/ttcp and www.rta.nato.int.)

DRDC actively participates in all 10 TTCP groups: the Sensor (SEN) Group; the Conventional Weapons Technology (WPN) Group; the Command, Control, Communications and Information Systems (C3I) Group; the Electronic Warfare Systems (EWS) Group; the Aerospace Systems (AER) Group; the Maritime Systems (MAR) Group; the Human Resources and Performance (HUM) Group; the Materials and Processing Technology (MAT) Group; the Chemical, Biological, and Radiological Defence (CBD) Group; and the Joint Systems and Analysis (JSA) Group.

DRDC contributes to NATO RTO through our participation in the six panels that span the spectrum of its research and technology activities: the Information Systems and Technology Panel, the Systems Concepts and Integration Panel, the Applied Vehicle Technology Panel, the Sensors and Electronics Technology Panel, the Human Factors and Medicine Panel and the Modelling and Simulation Group.

Of particular importance are DRDC's bilateral agreements with the United States, for example, the Technology Research and Development Projects (TRDP) agreement and the Master Data Exchange Arrangement (MDEA). These agreements form an important part of our strategy,

as they promote interoperability and give us exposure and access to the extensive defence technology base in the United States.

On behalf of the Department of National Defence, DRDC signed a Memorandum of Understanding (MOU) with the Netherlands' Ministry of Defence and the Swedish Defence Research Agency (FOI). The MOU, concerning cooperative science and technology, facilitates collaboration in all scientific areas in order to eliminate unnecessary duplication of work and to obtain the most efficient and cost-effective results through cooperation in joint research activities.

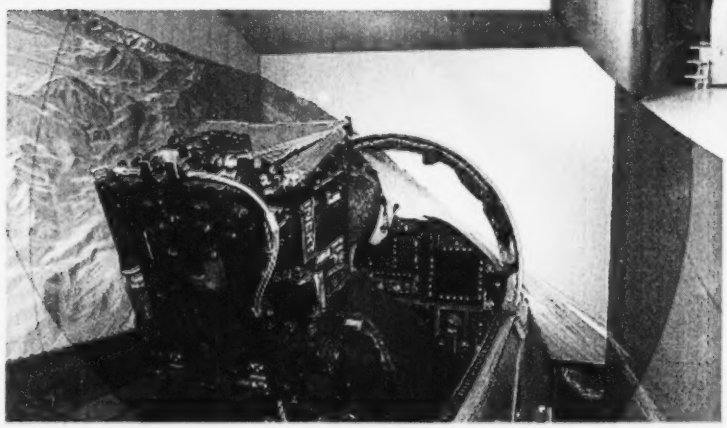
DRDC is also active in a number of multilateral agreements, including an agreement with the Netherlands and Sweden on integrating chemical and biological protection in a daily-wear combat uniform, and the Trilateral Technology Research and Development Projects (TTRDP) agreement with the United States and United Kingdom, under which we are helping to develop and characterize concepts for space-based surveillance systems.

The following stories highlight some of our collaborations with our allies.

FLYING IN SIMULATED COALITION EXERCISES

DRDC's partnership with the U.S. Air Force Research Laboratory (AFRL) led to the installation of the CF-18 Multi-Task Trainer (MTT) at one of our research centres. The MTT is a low-cost flight simulator designed to explore the concept of a network of geographically separate training simulators. The MTT was built for us by the AFRL to examine the many issues associated with distributed mission training. The MTT is fully interoperable with other simulators in the United States.

The MTT points the way to addressing inter-simulator networking issues, visual display fidelity, the use of constructive agents for friendly and opposing forces, and the right mix of simulator and in-flight training. Future collaborative activities with the United States and other allies will feature our simulation facilities used in a variety of coalition exercises.



The CF-18 Multi-Task Trainer

"Our two nations have been great partners for a long time... When you see the benefits to date, the enthusiasm on both sides [of the border] will increase our partnerships. We want to partner with the best, and in this field the Canadians are the best. There is no better country to practice missions with than Canada."

—Major-General Paul Nielsen, former Commander U.S. Air Force Research Laboratory

This work will help support the Air Force's Advanced Distributed Combat Training System project and other defence initiatives, by promoting better understanding of the key issues related to the use of simulation and modelling in equipment acquisition, operational analysis, training, mission planning and rehearsal.

TRAINING WITH LIVE AGENTS

DRDC's expertise in nuclear, biological and chemical defence allowed us to host a variety of international training sessions using live agents. One of the most notable sessions was Exercise Prototype Response, part of a year-long program of exercises and evaluation of nuclear, biological and chemical defence capabilities conducted by the NATO Senior Defence Group on Proliferation. The exercise provided the first opportunity for NATO teams to operate in a wide range of scenarios using live agents. In addition to Canada, exercises took place in the Czech Republic, Italy, Turkey, the United Kingdom and the United States. Lessons learned from the exercises, evaluations, and an analysis of the program formed the basis of recommendations to NATO Defence Ministers.

"DRDC Suffield is the only place where the Chemical Biological Incident Response Force trains with live agents, so the experience they gain at the centre is invaluable."

—1st Lieutenant, Paul Cabellon, Public Affairs Officer for the Chemical Biological Incident Response Force

We also conducted a season of training with the Chemical Biological Incident Response Force (CBIRF), a unit of the U.S. Marines formed to respond to the threat of chemical, biological, radiological, nuclear and explosive incidents. In the event of such an incident, the CBIRF assists local, state and federal agencies in consequence management operations.

As a signatory of the Chemical Weapons Convention, Canada does not develop or use chemical agents as weapons. However, we are permitted to use very small amounts of agents in trials for the purpose of maintaining effective defences against chemical warfare. The use of live agents gives trainees the confidence that their techniques and equipment will work in cases of real chemical contamination.

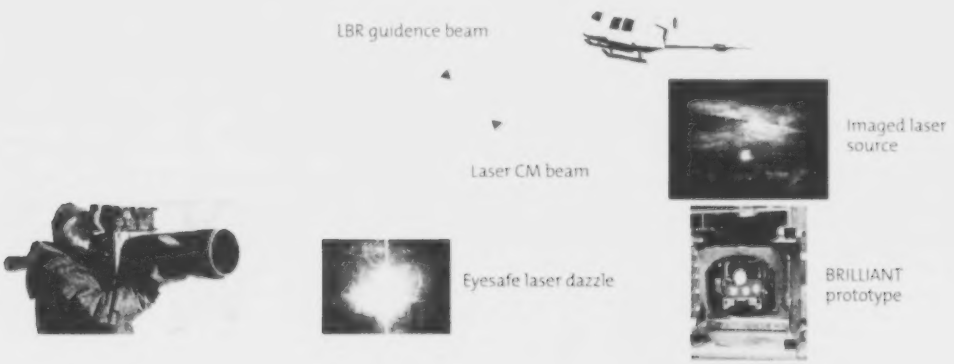
PARTICIPATING IN NATO TRIALS

In conjunction with the Netherlands and the United States, DRDC participated in the first field trial of the NATO Next Generation Autonomous Sensor joint research project. This project investigated multi-influence sensors that could be developed to provide an autonomous intelligence, surveillance and reconnaissance capability in coastal waters.

In collaboration with the United States, we also participated in mine jamming trials aboard a Maritime Coastal Defence Vessel (MCDV), as part of an ongoing NATO joint research project. During these trials, signals were injected into the MCDV's degaussing coils to produce magnetic fields on the seabed. These magnetic fields are intended to confuse or jam highly sophisticated multi-influence mines designed to reject influence sweeps that may actuate mines.

BRILLIANT

Beam Rider Laser Localization Imaging And Neutralization Tracker



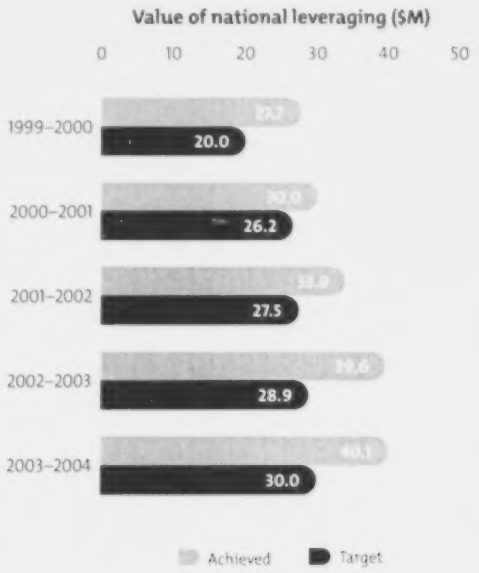
TESTING THE BRILLIANT

In collaboration with our allies, DRDC successfully tested in flight the Beam Rider Laser Localization Imaging And Neutralization Tracker (BRILLIANT) system, a countermeasures technique against advanced laser beam rider missiles. These laser-guided weapons combine precision with high lethality and jam resistance. The BRILLIANT is an electro-optical device capable of detecting, locating and defeating laser beam riders using a countermeasure based on an eyesafe laser dazzle. Whereas this test was the first in an airborne platform, previous tests had taken place on the ground and aboard ship.

Collaborating with National Organizations

Collaborating with national organizations, whether from industry, academia or government, constitutes an important part of DRDC's research and development program. Leveraging the expertise and resources of partners on joint projects increases the rate of return from our investment, providing additional value for money.

DRDC's goal is to leverage a value of $30 million each year from national collaborations. We estimate the value for our national leveraging in fiscal year 2003–2004 at $40.1 million. The following chart shows a five-year history of the value of our leveraging from national organizations.



The following stories highlight some of our collaborations with national organizations.

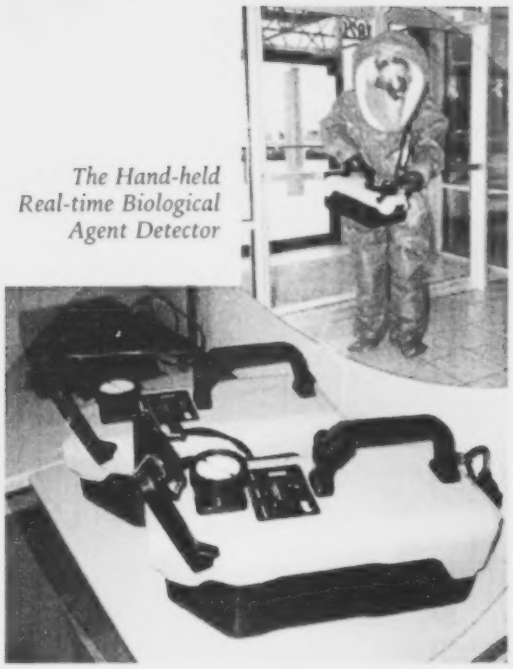
CAMOUFLAGING THE COYOTE

In partnership with GMA Cover Corp., DRDC developed a vehicle camouflage kit for the Canadian Forces' Coyote for use in battlefield reconnaissance and surveillance missions This signature reduction kit, called KARES (*Kit Amélioré de Réduction de la Signature*), helps to significantly reduce the acoustic, infrared and visual signatures of the Coyote, making them harder to detect and track. Composed of three distinct kits, the permanent camouflage and both long- and short-halt kits, KARES is designed to hide the vehicle from modern sensors and ultimately increase the survival chances of the Coyote in the battlefield.

The next step of the project will be to make the metallic structures of the permanent camouflage retractable in order to reduce the risk of damage in difficult terrain. Research is also under way to design and develop versions of KARES for arid and desert regions so that the Coyote can be deployed efficiently in those operational areas.

Coyote vehicle equipped with the KARES camouflage kit

The Hand-held Real-time Biological Agent Detector



DETECTING BIOLOGICAL AGENTS

Partnering with General Dynamics Canada Ltd., DRDC developed and introduced the Hand-held Real-time Biological Agent Detector, a battery operated, field-proven rapid bio-detector. Based on fluorescence particle detection technology, this device has the ability to detect aerosolized biological agents, usually in less than 20 seconds.

This technology will have particular application for first responders in a biological terrorism scenario, as it will provide firefighters and police officers with real-time aerosol detectors to confirm an attack, isolate the contaminated area, identify potential casualties and minimize secondary contamination.

REDUCING RADAR REFLECTIONS

In conjunction with Concordia University, DRDC is developing a computer program to calculate the Radar Cross Section (RCS) of Canadian Forces platforms. This program will provide a complete RCS picture and highlight areas that are prone to reflection, known as hot spots. The ability to model a ship's RCS can be used to minimize its signature, either at the design stage or by applying patches of radar absorbent material to hot-spot areas. Recent developments of this program include the mathematical formulations

The radar cross section (RCS) of a target is the projected area that would intercept the transmitted signal and reflect isotropically an amount that produces the returned signal at the receiver. In other words, radar cross section provides an indication of how well a given target reflects radar energy. Use of radar absorbent material (RAM) and specific shapes and angles helps to minimize the radar cross section.

—Reprinted from the Argos Press Radar Glossary with permission from Argos Press, 2004

that allow for determining RCS from platforms equipped with patches of radar absorbent material. This research will ultimately provide our ships with greater protection from detection by unfriendly forces.

HUNTING UNDERWATER MINES

In collaboration with MacDonald Dettwiler & Associates, ISE Research and Lockheed Martin Canada, DRDC successfully completed the development of the Remote Minehunting System (RMS) in the summer of 2003, meeting or exceeding the original design goals. The RMS is capable of transmitting data over safe operating distances, accurately localizes targets, demonstrates computer-aided detection and classification, and operates in extremely rough (sea state 5) conditions. Based on the success of this project, discussions are under way with the Navy regarding the use of the RMS to provide an interim remote minehunting capability to address current deficiencies.

The Remote Minehunting System

Expanding Our Networks

DRDC participated in many corporate marketing activities with a view to increasing our collaborative efforts and enhancing our visibility with industry, academia and our allies. These events provided excellent opportunities for us to demonstrate our capabilities as well as to learn from our colleagues and peers. They were beneficial also in attracting the best new employees and in making our research and development partners and the Canadian Forces more knowledgeable about the science and technologies at their disposal. Featured below are some of the notable events of the past year.

- Defence Innovation 2003, which we organized with PÔLE Québec Chaudière-Appalaches, had for its theme "Economic Partners in Innovation." The event brought together public and private sectors and featured several high-profile guest speakers, including the U.S. Consul General in Québec City. Some 350 representatives of the Canadian high-tech industry attended the event.
- Sponsored by the Canadian Defence Industries Association (CDIA), CANSEC 2003 brought together defence and national security practitioners and their counterparts in industry, with a view to potential future collaboration. This annual event provided an excellent opportunity for us to demonstrate our newest capabilities in both the defence and national security fields.
- We participated in the Paris Air Show 2003, aiming to increase our business development opportunities, independently as well as part of

our strategic alliance with the National Research Council. The Paris Air Show, held every two years, is the largest event of its kind in the world.

- The annual Federal Partners in Technology Transfer Annual Conference and Workshop provided an excellent opportunity for networking and promoting as well as a chance to learn from other experts in the innovation arena, including technology transfer and intellectual property management professionals.
- In collaboration with the Canadian Defence Industries Association (CDIA), we presented the CDIA–DRDC Technology Opportunities Day. In a change of format from previous years, the event focused on DRDC's key technological areas, including

  (1) Assessing and Transitioning Technology;

  (2) Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR);

  (3) Chemical, Biological, Radiological, Nuclear and Explosives detection;

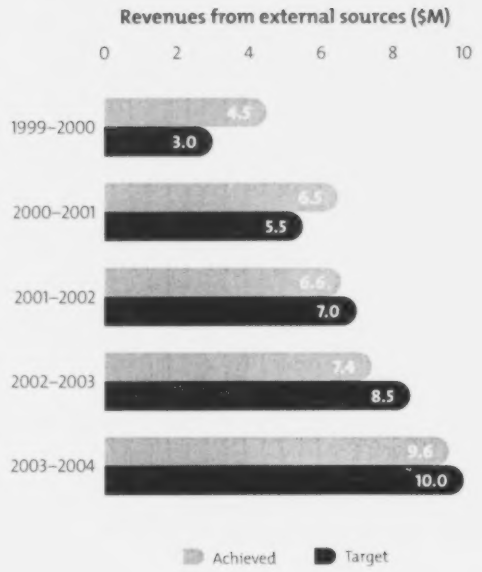
  (4) Enhancing Warrior Effectiveness; and

  (5) Information Operations.

Augmenting Our Capacity

We augment our scientific and technological capacity by offering our services to clients outside of the Department of National Defence and the Canadian Forces. By taking advantage of our expertise in niche technology areas, DRDC is able to increase opportunities to conduct more research and development and to maintain and build capacity to meet the needs of the Forces and to enhance national security.

DRDC's goal is to generate about $10 million in revenues each year from business development activities. This year, we were able to realize revenues of $9.6 million from external sources. The preceeding chart shows our history of revenue generation over the last five years.

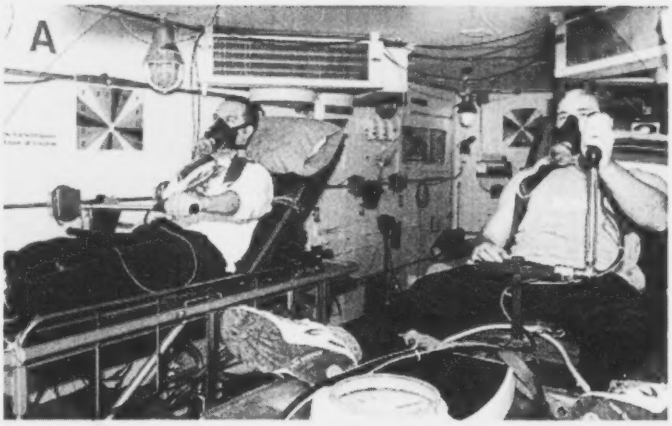


The following stories highlight some of the work we have done for clients outside of the Department of National Defence and the Canadian Forces.

REDUCING PREBREATHE TIMES FOR ASTRONAUTS

In an initiative funded by the Canadian Space Agency and partnered with the National Aeronautics and Space Administration (NASA) Johnson Space Center (JSC) and Duke University Medical Center, DRDC continued to play an important role as one of the testing centres in the Prebreathe Reduction Protocol Trials.

Usually astronauts must decompress from normal space station pressure in order to work outside the station in space suits with a lower internal



Participants in the Prebreathe Reduction Protocol Trials

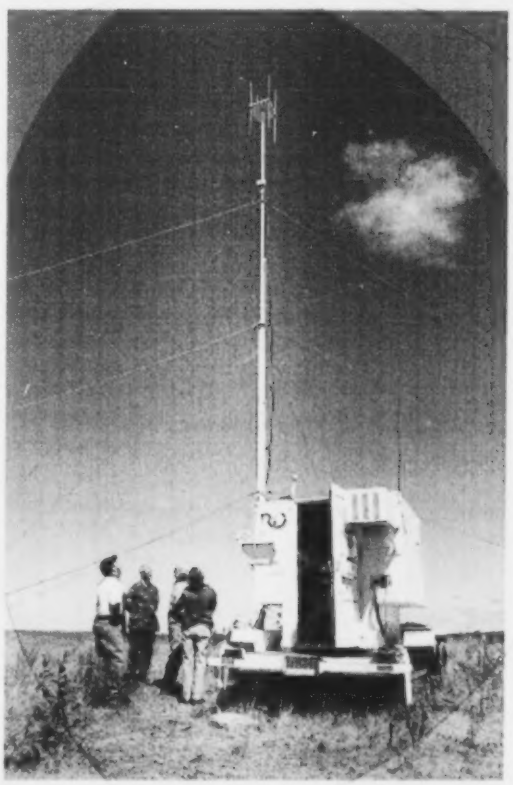
pressure. The change in pressure is great enough to generate a significant risk of decompression sickness. Astronauts must breathe oxygen prior to decompression (prebreathe) to eliminate nitrogen gas from tissues because it could cause decompression sickness. The standard four-hour oxygen prebreathe was too long for the schedule of spacewalks required to build and maintain the International Space Station. NASA JSC developed a series of prebreathe reduction protocols with the aim of reducing the prebreathe time to two hours.

Ongoing testing in the current Phase V aims to produce an in-suit protocol that will not only allow astronauts to do their prebreathe inside the space suit, but will also reduce the resources (oxygen) required to carry out the procedure.

While DRDC's revenue from this project was only about $250,000 over two years, the value of what we have gained through our participation has been priceless. We have acquired expertise in conducting high-altitude decompression research and experiments. Moreover, we have increased the value of the Canadian input to operations on the International Space Station and heightened the visibility and recognition of Canadian expertise in this area.

THE MIDAS TOUCH

The Military Digital Analysis System (MiDAS) is a sophisticated radio surveillance system designed to detect, analyze and localize the sources of communications signals. DRDC was awarded a contract for US$1.5 million to develop this system for the U.S. Marine Corps Systems Command. MiDAS uses commercial off-the-shelf (COTS) antennas, tuners and digitizers in concert with software running under the Windows 2000 operating system on a server class computer. The combination of advanced digital signal processing techniques and the innovative application of COTS technology provides a cost-effective, multi-purpose capability.



The Military Digital Analysis System (MiDAS)

Strengthening Our Foundation

At DRDC, our people are our most important asset. The hard work of our scientists and technologists, our engineers and administrators, and the wealth of other professionals and members of the military on our staff roster make our agency a vibrant and stimulating organization. Our people provide the expertise, insight, vitality and innovative spirit on which our achievements are founded and our reputation is built.

In order for our people to do their best work and reach their full potential, they need to be provided with the proper facilities and tools in a motivating and supportive environment. We are committed to strengthening our physical infrastructure and our management policies and practices to ensure that we remain effective and achieve our vision.

Nurturing Our People

DRDC continues to support its people by introducing new initiatives and furthering government and departmental programs that enrich the work environment. Here we present some of our activities that contribute to nourishing a supportive workplace.

DEFINING COMPETENCIES FOR THE TECHNOLOGY COMMUNITY

In 2001, DRDC initiated the Competency and Career Management project to define the competencies required by our employees. After defining core competencies for all employees based upon our organization's values, we turned our efforts to determining the competencies for the four career streams: science, technology, management and corporate services.

Over the past year, the Technology Stream Working Group (TSWG), made up of employees and union representatives, developed and validated five competencies for the technology career stream using focus groups across DRDC. The TSWG aligned its efforts with other career management initiatives geared to the technology community, including those of DRDC and of the Department of National Defence.

DEVELOPING OUR FUTURE LEADERS

DRDC launched the Mentoring Program Pilot Project in November 2003 with the initial formation of 22 pairs of mentees and mentors. Group Leaders comprised the pilot population of mentees, while the mentors were typically at the level of Director General and Director (Deputy Director General and Chief Scientist in the research centres).

After six months of operation, a review of the pilot indicated that the project was flourishing. While not all pairings had met with the same level of success, the majority felt that their mentoring experience had had a positive effect. Group Leaders remarked that the unique relationship they had established with senior managers had given them a much better understanding of the organization. Mentors indicated that they had benefited from the opportunity to share their wisdom and experience and that they had gained a better appreciation of what Group Leaders were experiencing.

SUPPORTING THE USE OF OFFICIAL LANGUAGES

DRDC is committed to bringing about the changes needed in our organizational culture to enhance the use of Canada's official languages in the workplace. To this end, we have adopted strategies such as hiring more bilingual candidates, including language training in learning plans, and supporting early language training and the retention and improvement of language skills. With these measures, we are able not only to fulfill our obligations under the *Official Languages Act*, but also to work towards creating a workplace where employees feel free to use the official language of their choice.

"A unique relationship has been established that I cannot find with other colleagues in the organization. Insightful perspectives [were] provided on corporate and career management issues."

—THE MID-TERM REPORT ON DRDC PILOT MENTOR PROJECT

STRENGTHENING MANAGEMENT ACCOUNTABILITY

During the course of the year DRDC developed and administered a series of training sessions in financial and human resources management, including values-based staffing. This training will make our managers and supervisors aware of their management responsibilities and accountabilities and will assist in fostering a healthy work environment and becoming an employer of choice.

WORKING TOWARDS EMPLOYMENT EQUITY

The *DRDC Employment Equity Plan* identifies goals for increasing the representation of the four designated groups: visible minorities, persons with disabilities, Aboriginal peoples and women. We have also developed specific recruitment measures, such as using job fairs and inventories, expanding or restricting areas of selection and taking advantage of government programs—for example, the Co-operative Education Program and the Federal Student Work Experience Program—to hire the people we need, when and where we need them. Activities such as career development, diversity training and supporting an inclusive workplace help to retain our employees and improve our ability to attract the best candidates. In addition, we actively participate in the science and technology community work groups on Women in Science and Technology, Persons with Disabilities and the Aboriginal Youth Program.

Recognizing Our Achievements

We demonstrate pride in our people by recognizing their achievements, knowing that the accomplishments of our staff contribute to DRDC's growing reputation on the world stage.

Starting with this issue of DRDC's Annual Report, we are taking a different approach to recognizing the significant achievements of our employees. In the past, we reported the receipt of awards based on the fiscal year in which the award was presented. As a result, some achievements were reported as many as two years after the fact. In this issue, we begin reporting the presentation of awards for the year in which the work was accomplished, recognizing our successes in a more timely fashion.

COMMEMORATIVE MEDAL TO MARK THE QUEEN'S GOLDEN JUBILEE

Created to mark the 50-year reign of Elizabeth II as Queen of Canada, the Queen's Golden Jubilee Medal recognizes Canadian citizens who have made a significant contribution to their fellow citizens, to their community or to Canada. Thirty-three of our employees were recipients of the medal.

Luc Bissonnette
Nicole Brousseau
Mary Ellen Campbell
Col (Ret) Bert Desjardins
LCol John Dick
LCdr Al Graham
LCol M.J. Haines
George Haslam
Maj Kent Hocevar
Stéphane Jean
Alfred Jeffrey
Ken Johnson
Maj Pierre La Pierre
Maj Rod Mackay
Craig Maskell
Rob Matheson
Carol McCann
MWO Arthur Moores
Danny Morehouse
Jack Morrison
Ronald Nishi
Daniel Ouellet
Cdr Dan Parks
LCol Paul Poirier
Dan Prawdzik
Renita Repsys
Lynn Rockwell
Maj Richard Round
Merzban Rustom
Maj A.M. Shurson
Malcolm Vant
Jos Verreault
Kevin Whalen

DEPARTMENTAL AWARDS

Stephan Flemming received a Deputy Minister Commendation for his leadership of the most comprehensive social scientific inquiry in the history of the Canadian Forces. His research project studied the incidence and impacts of more frequent operational deployment and higher workload on military members, their families and the Canadian Forces. He provided outstanding data and findings that are operationally relevant to the development of human resources policy for the military.

Jean-Denis Caron was awarded a Deputy Minister Commendation for his exceptional contribution to the NATO Flying Training in Canada Program (NFTC). He initiated the development of a robust, generic model to meet the needs of the NFTC Program. This model has since become the *de facto* standard for NFTC Resource Allocation decision-making.

LCol Carl Walker was awarded the Chief of Air Staff's Air Command Commendation for his outstanding professionalism and commitment to advancing standards in aerospace medicine. LCol Walker has set high medical standards for search and rescue technicians, flight surgeons and aero-medical evacuation personnel within both the Canadian Forces and the international community.

Peter Holtham received a Maritime Command Bravo Zulu for outstanding scientific and technical leadership during preparations and deployment of the Canadian Navy for Operation Apollo. Dr. Holtham led the research into estimating the mine vulnerability of all Operation Apollo warships and minimizing their underwater signatures, which are used by naval mines to detect ships.

DRDC RECOGNITION AWARDS

Performance Excellence Awards

Serge Choquette, for his significant contributions to DRDC through his skilful leadership of the infrastructure and environment program;

Cary Risley, for his creativity, leadership and dedication in developing world-class acoustic technologies;

John Bovenkamp, for his exceptional achievement in spearheading DRDC's Simulation and Modelling for Acquisition, Requirements, Rehearsal and Training (SMARRT) Program;

John Porter, in recognition of many years of performing at the highest level, demonstrating outstanding leadership, creative thinking and problem-solving abilities in the completion of many successful and significant research and development projects;

Denis Gouin, for his exceptional work related to the creation and deployment of two successful major projects: the Electronic Battle Box and the Engineer, Command, Control and Operations;

Fred Cameron and **Roger Roy**, for their outstanding contribution to the development of capabilities and concepts for Canada's future army; and

John Frim, **Gilles Pageau**, **LCol Linda Bossi**, **LCol Mike Bodner**, **David Tack** and **Diana Darling-Mitchell** for their outstanding contributions in the highly successful Soldier Information Requirements (SIREQ) technology demonstration project.

Awards of Public Distinction

Clément Laforce, for his tireless dedication to science and the community;

Doug Laurie-Lean, for fostering DRDC's reputation with industry over the years as leader of the Defence Industrial Research Program; and

Gilles Bérubé, **Claire Gagnon**, **Lise Ladouceur**, **Gabriel Otis**, **Jocelyn Tremblay**, **Alain Bouchard**, **Jocelyne Audy**, **Anne Clément** and **Brian Eatock** for their outstanding contributions and commitment to the highly successful conference "Defence Innovation 2003."

Outstanding Performance Awards

David Brown, **LCol Paul Poirier** and **Aaron Ellis**, who exemplified initiative, commitment, professionalism and the willingness to go the extra mile.

Renewing Our Infrastructure

DRDC currently occupies facilities that include approximately 335 buildings, 400 square kilometres of land and hundreds of kilometres of roads and over/underground utilities. Over the past 10 years, as a result of severe funding reductions, minimal investment was injected into our infrastructure, resulting in significant deterioration of our facilities.

The majority of the main research facilities were built during the period from 1940 to 1965, with no recent upgrades since the mid-1980s. Consequently, the electrical, mechanical, structural and architectural systems, built according to design concepts of the past, are not well adapted to today's quickly changing requirements. In addition, more stringent health and safety codes and standards are now in effect and are intensifying the need to upgrade our facilities. Major recapitalization or replacement work is necessary to overcome the current situation.

Beginning this fiscal year, DRDC received a recurring $6 million increase in our infrastructure and environment budget, along with additional funding for specific projects, which has allowed us to embark on revitalizing aging facilities and to ensure that our research activities are conducted in an environmentally responsible way.

The following chart shows our expenditures on capital construction over the last five fiscal years.

Some of the activities related to the renewal of our infrastructure include major renovation projects at DRDC Atlantic, the significant upgrading of electrical and mechanical systems and review of building codes at DRDC Toronto, and the improvement of municipal services (roads, electrical power network, water supply) in the Experimental Proving Grounds at DRDC Suffield. The design of a new building at DRDC Ottawa is under way and we are seeking approval for a major renewal project to replace the infrastructure at DRDC Valcartier.

Protecting our Environment

In keeping with our corporate values of commitment, creativity and innovation, professionalism and integrity, DRDC has demonstrated leadership by becoming one of the first federal science and technology organizations to implement its own environmental policy.

We realize that our actions and activities may have a profound impact on the environment. Consequently, we have begun to incorporate environmental considerations into our management policies and research activities with a view to ensuring sustainable development and continual improvement.

DRDC's environmental policy ensures the responsible management of our activities and lays the foundation for an environmental management system (EMS) based on the management model of the international standard ISO 14001.

In addition, we have initiated a major effort to assess and remediate sites contaminated from past activities. Three projects are currently under way, related to the contamination of groundwater by trichloroethylene (TCE) at DRDC Valcartier, contaminated sites at DRDC Suffield, and former disposal pits at DRDC Ottawa.

Continual Improvement
Environmental Policy
Planning
Implementation and Operation
Checking and Corrective Action
Management Review
Management steps guiding implementation of the EMS in accordance with the ISO 14001 standard.

Promoting Operational Excellence

At DRDC, we strive to achieve excellence in the way we conduct all of our operations. We work hard to deliver high-quality and timely scientific and technological products and services to the Canadian Forces and the Department of National Defence.

In this chapter, we highlight the ways in which we deliver our technical programs, build effective relationships with our customers, and strengthen our internal processes, all of which are aimed at promoting operational excellence.

Leading in Niche Technology Areas

DRDC's vision is to be known worldwide as the best in science and technology for defence and security. We strive to realize our vision through leadership in the niche technology areas defined by the Technology Investment Strategy.

TECHNOLOGY INVESTMENT STRATEGY

The Technology Investment Strategy (TIS) outlines the areas that DRDC expects to be critical to the Canadian Forces over the next 10 to 15 years. It describes how we plan to develop the capacity to address the future requirements for defence and national security in 22 areas that span the defence technology spectrum: sensors and information systems, combat systems and human systems. It takes into account the direction provided by *Shaping the Future of the Canadian Forces: A Strategy for 2020* and involves both the reallocation of existing resources and new investments.

Our efforts to implement the TIS have been largely successful. While we have experienced some difficulties in obtaining approval to fund growth areas, we have been able to recruit 145 of the 260 new science and technology workers we need. This brings our total complement of science and technology workers to 993, which is about 87% of our goal of 1138. (For a complete description of the TIS,visit our web site at www.drdc-rddc.gc.ca/researchtech/investment_e.asp.)

CONDUCTING RESEARCH AND DEVELOPMENT

DRDC focusses its research and development activities in areas of critical importance to future Canadian Forces operations. Our key objective is to ensure that the Forces are technologically prepared for operating in a defence environment that will see increased emphasis on interoperability with allies, technology-driven warfare and new asymmetric threats.

Our Research and Development Program is delivered through *thrusts*—packages of scientific and technical activities that are developed in consultation with our clients in the Canadian Forces. Each thrust addresses a broad spectrum of issues and involves a team of our staff working with external partners, including academia, industry and allies.

We carry out our Research and Development Program through two interconnected mechanisms: the Applied Research Program and the Technology Demonstration Program. In addition, the Technology Investment Fund and the Defence Industrial Research Program provide funding to our scientists and Canadian industry for smaller projects that are managed as part of the Applied Research Program and the Technology Demonstration Program.

Applied Research Program

The Applied Research Program (ARP) is designed to advance the knowledge base of defence science, investigate novel and emerging technologies and explore the military application of those technologies. It is an evolution of our former Technology Investigation and Technology Application programs, and is intended to provide better response to client needs while maintaining the same budget.

In fiscal year 2003–2004, the total value of all resources expended on the 109 active ARP projects was about $113.1 million. This included the full-time equivalent of about 350 science and technology workers, supported by $35.2 million in annual contract funds and $19.5 million from external cash and in-kind contributions. (See Table 2 at the end of this report for more information about the active ARP projects.)

Technology Demonstration Program

The Technology Demonstration Program (TDP) is designed to meet the challenges of developing new defence capability in the face of rapidly changing missions. Its objective is to demonstrate new technologies within the context of future capabilities, concepts, doctrine, operations and equipment for the Canadian Forces. The TDP is typically aimed at technology evaluation and concept validation, with projects spanning three to four years in duration.

The total value of all resources expended on the 38 active Technology Demonstration projects in fiscal year 2003–2004 was about $66.3 million. This included $33.4 million for contracted research and development and $9.9 million from external cash and in-kind contributions. The remainder comes from the efforts of some 146 of our science and technology workers. (See Table 3 at the end of this report for more information about the active TDP projects.)

We approved several new Technology Demonstration projects, including the following, due to start in fiscal year 2004-2005:

- **Interoperable Combat Fluid Resuscitation Capability** – The objectives of this project are to coordinate and participate in trials using hypertonic fluid resuscitation in order to reduce the need for other resuscitation and life-support measures, and to improve survival, clinical outcome and the overall well-being of survivors by reducing inflammatory complications.
- **Advanced Integrated Multi-Sensing Surveillance System** – This project will demonstrate a multi-sensing system capable of extending the capability of the Canadian Forces to conduct diverse missions, particularly at night and in adverse weather conditions. The goal is to enhance the effectiveness of current airborne search vehicles and future Unmanned Aerial Vehicles by increasing surveillance and reconnaissance capabilities while optimizing the detection and identification of small objects.
- **Space-Based Hyperspectral Image Exploitation** – This technology will enhance military geomatics, intelligence, surveillance and reconnaissance capabilities—such as the detection of low-visibility, camouflaged or shadowed targets—as well as the classification of targets and backgrounds.
- **Multi-Sensor Torpedo Detection, Classification and Localization** – This new technology aims to reliably detect, classify and localize torpedoes through signal processing and integrated processing of sonar systems—including hull-mounted sonar, towed arrays, and sonobuoys—combined into an overall torpedo defence system.
- **Code Division Multiple Access Geolocation Demonstrator** – This project will demonstrate non-cooperative identification methods to geographically locate Code Division Multiple Access mode cellular and Personal Communications System handsets. This capability is critical for the Canadian Forces in peacekeeping, low-intensity conflict, urban operations, and maritime coastal surveillance and patrol scenarios.

Technology Investment Fund

The Technology Investment Fund (TIF) supports forward-looking, high-risk but potentially high-payoff, research projects with potential for significant impact on military applications. External reviewers from universities and other research organizations assess each proposal based on scientific merit, technical methodology, team capability and novelty. Proposals are also evaluated for probable military impact and for consistency with the Technology Investment Strategy.

Typical projects are three years in duration, with a total contract budget of up to $750,000. The results of successful TIF projects are subsequently absorbed into our Applied Research Program, thereby ensuring effective impact and uptake of groundbreaking research.

"Many of these new TIF projects include a very strong element of collaboration, both internally and externally. Many centres will be working together as well as with exceptional national and international partners. In this way, the TIF program fosters internal competencies in addition to building important external networks as we better prepare our Canadian Forces in the ever-changing capability-based environment."

—Bill Macmillan, TIF Coordinator

We approved 10 new projects under the Technology Investment Fund to start in fiscal year 2004-2005. The projects range from the integrated cognitive and physiological monitoring of human performance to the development of a practical capability for emerging energetic material simulation at the atomic level.

The Technology Investment Fund sponsored 29 projects in fiscal year 2003–2004. The fund provided $5.9 million in contract funds in 2003–2004, with our research centres contributing about $3.2 million in funds. In addition, there were about $1.4 million of external contributions. (See Table 4 at the end of this report for more information about the active projects funded by the TIF.)

Defence Industrial Research Program

The Defence Industrial Research (DIR) Program is our approach to working with small and medium-sized enterprises to identify and exploit emerging technologies with potential defence applications.

In fiscal year 2003–2004, there were 31 active projects in the DIR portfolio with a combined resource expenditure of $11.5 million. DRDC provided $5.3 million in contract funds, while external and in-kind contributions accounted for the balance of $6.2 million. (See Table 5 at the end of this report for more information about the active projects funded by the DIR Program.)

▸ PROVIDING ADVICE ON SCIENCE AND TECHNOLOGY

DRDC provides strategic and operational advice to the Canadian Forces and the Department of National Defence on products and services related to science and technology. This includes policy advice, strategic studies, support for scientific and technical intelligence, technology watch, support to operations, and outreach activities. (See Table 6 at the end of this report for a list of the projects that provide advice to the Department of National Defence and the Canadian Forces on science and technology.)

Technology Outlook Program

The objective of the Technology Outlook Program is to seek out emerging technologies, assess their potential relevance to the Canadian Forces, and provide advice on the potential impact of scientific and technological developments on national and departmental policies and strategies.

Scientific and technical intelligence support and advice

DRDC provides scientific and technical intelligence support and advice to the Canadian Forces and the Department of National Defence in the areas of weapons; chemical and biological defence; command, control and information systems; and surveillance and counter-surveillance systems.

Scientific and technical services for operations

The objective of this element of our program is to support the current operations of Canada's military, particularly in the areas of Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR); medical and health services; training; Chemical, Biological, Radiological and Nuclear capacity; and marine materials consulting.

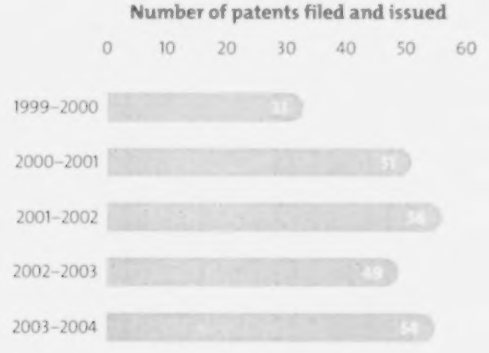
Operational research

DRDC provides operational research, analytical support and advice to the Canadian Forces and the Department of National Defence. We use physics-based modelling, statistics, analysis, and other methods such as simulation and strategic analysis,

to help answer a wide range of questions. We also observe, plan and analyze military operations, exercises and field trials, and compare the results of these analyses with those of theoretical models.

CAPITALIZING ON OUR INTELLECTUAL PROPERTY

The past year was an extremely active one in the management and exploitation of our intellectual property, including patents, copyrights, trademarks and licences. Over the course of the year, DRDC was granted 15 patents and filed 39 new patents. (See Table 7 for a list of patents granted.) The following chart shows a five-year history of our patent activities.



In addition, we issued two licences to Canadian companies for the commercial exploitation of our technologies. One licence was granted to CANAMET for Non-invasive Medical Monitoring Devices and the other to Array Systems Computing Inc. for Demultiplex software.

We received $1.12 million in royalties; of this amount we passed more than $300,000 to our inventors.

RECOGNIZING SCIENTIFIC EXCELLENCE

The Technical Cooperation Program (TTCP) recognized 11 of our scientists for their significant contributions to enhancing the technological might of military forces in Canada, the United States, the United Kingdom, Australia and New Zealand:

Nicole Collison, **Ian Fraser** and **Brian Maranda** for developing Technology and System Concepts for the multi-static detection of submarines and evaluating them through an ambitious program of collaborative at-sea experimentation, data exchanges and scientific analyses;

Calvin Hyatt for significant contributions to developing the scientific knowledge and proof-of-concept for the confident use of laser weld cladding for the repair, fabrication and life extension of nickel-aluminum-bronze components of naval ships and submarines;

Nezih Mrad for significant contributions to collaborative research on embedded sensors in bonded repair patches for aircraft structures;

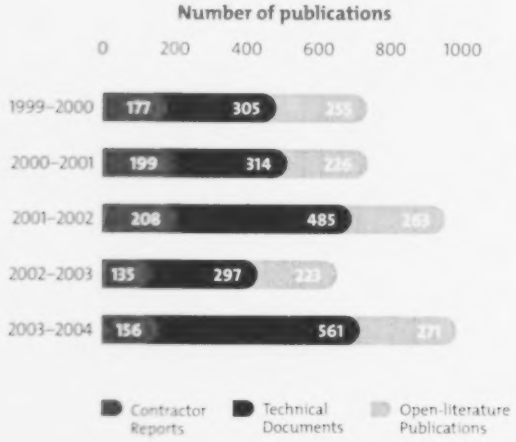
Tom Ollevier for significant contributions and achievements in deriving and demonstrating novel countermeasures for the enhanced survivability of surface platforms against modern military radar threats;

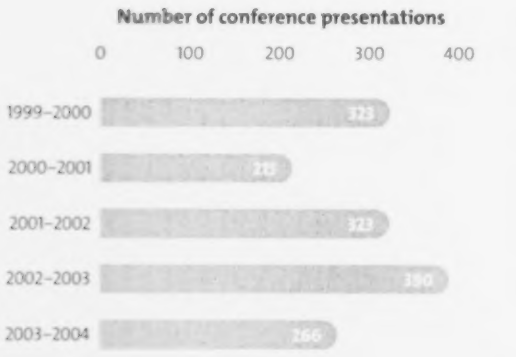
Hing-Chun Chan and **Tasos Drosopoulos** for a significant contribution to the joint characterization of non-Gaussian or "spiky" sea clutter and to the detection of periscopes in sea clutter; and

Scott Duncan, **Tom McLellan** and **Julie Tremblay-Lutter** for research into the protective performance, physiological strain and predicted performance of the leading developmental low-burden Chemical/Biological suit of each participating nation.

PROMOTING OUR FINDINGS

DRDC contributes to the transfer of knowledge to clients in the Canadian Forces and the Department of National Defence and to colleagues in industry, academia and government by promoting the results of our research and development activities, either through publication or conference presentation. These are means of demonstrating our expertise and enhancing our image. The following charts show histories of our publication and presentation activities over the last five years.





Enabling Effective Partnerships

To ensure continuing relevance to the Canadian Forces, DRDC needs to be engaged with them through simple and effective client relationships. Working closely with the Forces as they transform and evolve, we strive to create the internal conditions that build and sustain this vital partnership. Aligning our activities with theirs helps strengthen this relationship, which results in strategies and technological developments that serve their needs now and in the future.

IMPROVING STRATEGIC ALIGNMENT

DRDC successfully improved the alignment between existing Technology Demonstration Projects (TDP) and the current Navy acquisition projects, most notably the Halifax Modernization Command and Control System (HMCCS). This effort was the first success in developing a strategic TDP campaign plan for the Navy.

Through the Underwater Warfare (UWW) Way Ahead Study, we developed a coordinated program for UWW research and development, with specific projects and planning objectives that address the Navy's major priority areas over the short, medium and long term. The projects are also aligned with the Department of National Defence Strategic Capability Initiatives Plan, to ensure that the operational impact of the work is maximized. The resulting program also conforms with the reduced resource envelope allotted to UWW Thrust.

DRDC developed a strategic plan for research and development on Information Operations (IO) that will govern IO priorities and guide the selection of Applied Research projects. The plan specified three broad strategic goals:

(1) lead in the creation of seven new Information Operation capabilities in the Canadian Forces and the Department of National Defence;

(2) develop concepts of operations for the coalition battle in information space; and

(3) develop influence operations.

The plan links its objectives with *Shaping the Future of the Canadian Forces: A Strategy for 2020*, the Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) Campaign Plan, and the Technology Investment Strategy.

In order to revamp the oversight and strategic management of the research and development program for the Air Force, DRDC is in the process of implementing a key change in its governance structure. Oversight of this component of the research and development program will be integrated with the Air Force Development Committee (AFDC) to more closely align science and technology with the overall force development process. An example of such an alignment is the new science and technology program we have formulated, which is linked to the nine critical future capabilities the Air Force needs to acquire over the next 10 years. This new program will help the Air Force to achieve its vision and provide for more effective collaboration.

DRDC established the Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR) Capability Transition Group (CTG) to assist stakeholders in leveraging research and development resources to support their transformation and convergence efforts. The CTG will scout for innovative ideas and technologies, help bridge the gap between the research and development community and the military operational community, and facilitate the timely transition of research and development products into an initial operational capability. The efforts of the C4ISR CTG will foster a better understanding of the military reality, which will result in closer links between communities and improved alignment of research and development projects with military needs.

PARTNERING WITH THE CANADIAN FORCES COLLEGE

The Canadian Forces College (CFC) shares with DRDC the objective of generating and sharing knowledge that is scientifically rigorous, novel in approach and relevant to the Canadian Forces. We formalized our relationship with the CFC by signing a Memorandum of Understanding that provides a framework for facilitating and encouraging scientific and educational collaboration.

Our interaction with the CFC is not new; it has increased substantially in recent years. In addition to being regular lecturers and attendees at the college, some of our scientists acted as thesis advisors for students in the Masters of Defence Studies program and as subject matter experts for major course papers. Our scientists also participated in special symposia and syndicate discussions at CFC.

We have benefited greatly from our association with CFC. Scientists have had the opportunity to expose their research to bright, motivated and experienced students who, in turn, have critiqued the relevance of the science and commented on its validity.

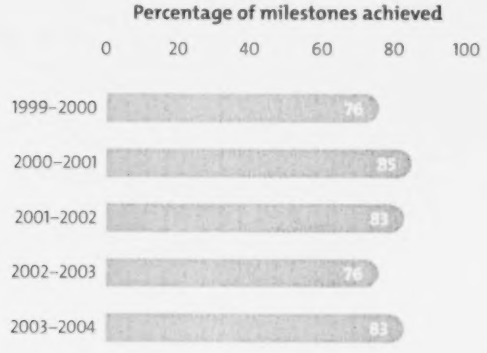
Excelling in Service Delivery

One of the ways DRDC strives to achieve excellence is to ensure that we deliver our products and services on time and within budget. We develop milestones for each project and measure our performance against those milestones. This helps to tell us whether we are meeting our deadlines and providing services in a timely manner.

We aim for excellence in the way we communicate, not only with our clients but among ourselves as well. We also seek to continuously improve our internal processes so that we become more efficient and more effective, and increasingly able to meet the needs of our clients.

ACHIEVING OUR MILESTONES

The following chart shows DRDC's five-year performance in meeting the project milestones that we have developed with our clients. This year, we achieved a completion rate of 83 per cent of 581 milestones. It should be noted that milestone completion will never reach 100 per cent, given the uncertainty inherent in the conduct of research and development activities.



IMPROVING COMMUNICATIONS AND VISIBILITY

As a result of proactive communication programs and a commitment to effective client services, public awareness and understanding of DRDC's leadership in science and technology have increased over the past year. Branding who we are and what we do has also been a key achievement, resulting from increased visibility of our corporate identity. For example, during the 2003–2004 fiscal period, almost 100 references to DRDC appeared in print and broadcast sources.

More and more, our employees are being called upon to share their knowledge and expertise as members of departmental and interdepartmental committees and working groups. We benefit from these activities, which help to close the gap between ourselves and other science and technology organizations, increase awareness of our business, and make our name known within the public and private sectors.

Internally, we have also made progress in improving the way we communicate. Through committees such as the Corporate Services Management Committee, efforts have resulted in better cooperation between our research centres, a stronger commitment to teamwork, effective corporate service delivery and the introduction of common processes that increase efficiencies.

IMPROVED INFORMATION SHARING

At DRDC, we have worked strenuously to improve our knowledge and information management systems and, as a result, our scientists are now better able to share the results of their work with clients and colleagues. Over the past few years, we have received many suggestions on how to improve the tools we provide to scientists to facilitate publishing. Funding from the National Defence Online program has enabled us to incorporate some of these suggestions as we revamp the publishing process.

Our colleagues in Australia and the United States now have easier access to our publications by using our new online searching and ordering system. Replacing a paper-based ordering process, the new system accelerates the process from weeks to days. Although the system is currently available to the United States and Australia only, versions for the United Kingdom and New Zealand are also being prepared.

We have improved access to the Canadian Defence Information Database (CANDID) for our clients in the Canadian Forces by installing a new CANDID server on the Defence Information Network. This has vastly reduced download times for members of the Forces accessing CANDID and provided them with online access to limited-distribution documents.

PROCESS MAP ONLINE

DRDC introduced Process Map Online (PMOL), a web-based tool, to outline its key internal processes to employees. Located on our internal web site, the listing of methods and procedures allows employees to follow set standards that are applicable across the entire organization. PMOL provides information that is up-to-date, accurate and consistent. A revised policy on security clearances, the process to deal with hazardous materials spills, and the *Delegation of Human Resources Authorities* are examples of the new entries that have been made to the PMOL library in the past year.

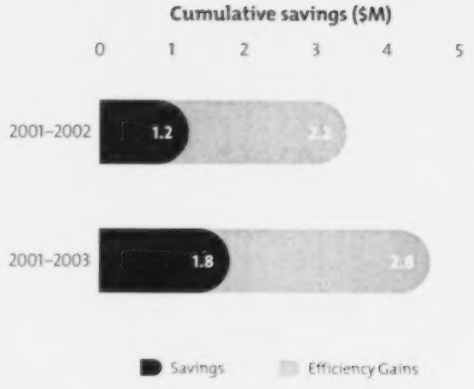
EFFICIENCIES AND SAVINGS

By becoming more efficient, we are meeting one of our key corporate commitments. Cumulative "vertical hard dollar" savings have totalled $4.6 million during the years 2001 to 2003. In most cases, the savings have been invested in administrative and support activities.

"Vertical hard dollar" savings fall into two basic categories:

- *Savings* resulting from reduction in the cost of delivering a service or performing an activity (for example, savings due to the rationalization of software applications); and
- *Efficiency gains* resulting from doing more with the same resources (for example, delivering corporate services to an increased complement of scientists and technologists with the same level of resources).

The following chart shows the cumulative savings we have realized in fiscal years 2001-02 through 2002-03. Our goal is to eventually realize $6 million in savings.



Financial Statement

This table summarizes the funds DRDC received and expended in fiscal year 2003–2004 to carry out its program. The values shown are thousands of dollars, with negative variances shown in parentheses.

FUND TYPE	REVENUES ($000)	EXPENDITURES ($000)	VARIANCE ($000)
Salary and Wages	82,392	95,364	(12,972)
Operations and Maintenance	30,458	28,024	2,434
R&D Contracting	90,791	81,528	9,263
Capital R&D Equipment	6,874	7,287	(413)
Capital Construction	4,094	3,806	288
Environment	1,700	1,364	336
Corporate Initiatives	3,727	2,720	1,007
CCMAT – Salary and Wages	445	452	(7)
CCMAT – Operations and Maintenance	2,466	1,926	540
CRTI – Salary and Wages	617	657	(40)
CRTI – Operations and Maintenance	500	497	3
CRTI – R&D Contracting	26,840	18,089	8,751
CRTI – Capital Equipment	7,500	7,733	(233)
Local Revenues & Intellectual Property	5,361	0	5,361
Revenues from Collaborative Agreements	3,130	0	3,130
Transfers from Other Government Departments	1,101	0	1,101
TOTAL	**267,996**	**249,447**	**18,549**

Notes:

- The difference between the Revenues and the Expenditures for 2003–2004 is due to the following:
  - Salary and wage costs were higher than anticipated due to terminable allowances paid to certain employment groups and negotiated salary increases.
  - The variance in research and development contracting, including that of CRTI, was due to slippage.
- CCMAT is the Canadian Centre for Mine Action Technologies.
- CRTI is the Chemical, Biological, Radiological and Nuclear (CBRN) Research and Technology Initiative.

Tables

TABLE 1: DEFENCE R&D CANADA'S CENTRES

Defence Research and Development Canada (DRDC) is made up of six research centres—each with a unique combination of expertise and facilities to carry out world-class research and development—in addition to a programs centre and a corporate services centre.

Defence R&D Canada – Atlantic

DRDC Atlantic conducts research and development in the areas of underwater sensing and countermeasures, naval command and control information systems, naval platforms, air platforms, signature management, emerging materials, and modelling and simulation. These research and development activities support operations, acquisition, maintenance, and requirements planning by Canada's Navy and Air Force.

Defence R&D Canada – Valcartier

DRDC Valcartier is our main facility for combat, optronics and information systems. Scientists and technicians from all these disciplines cooperate closely in dealing with complex integration issues in order to support the current and future operations of the Canadian Forces.

Defence R&D Canada – Ottawa

DRDC Ottawa is our lead authority and centre of expertise for radio frequency communications, sensing and electronic warfare, space systems, network information operations, synthetic environments, and radiological defence.

Defence R&D Canada – Toronto

DRDC Toronto is Canada's leader for defence research and development in human protection and performance in extreme environments, human-systems integration, command effectiveness and behaviour, simulation and modelling, and military operational medicine. Its mission is to enhance the effectiveness and ensure the health and safety of the human in any human-machine system or adverse environment.

Defence R&D Canada – Suffield

DRDC Suffield conducts research and development in areas generally related to military engineering, mobility systems, weapons system evaluation and chemical/biological defence. The Canada Centre for Mine Action Technologies and the Counter-Terrorism Technology Centre are co-located with and supported by DRDC Suffield.

Defence R&D Canada – Centre for Operational Research and Analysis (CORA)

DRDC CORA provides expert, objective and timely operational research, analytical support, and advice to the Canadian Forces and the Department of National Defence. The effort supports force development, resource allocation, acquisition, improved operational effectiveness and efficiency, and the achievement of departmental policy and human resource goals.

Defence R&D Canada – Programs

DRDC Programs provides central coordination and strategic planning for our science and technology programs through interfaces with our client groups in the Canadian Forces and with external partners.

Defence R&D Canada – Corporate Services

DRDC Corporate Services provides functional direction and central management of our corporate services and acts as an interface between DRDC, the Department of National Defence and the Government of Canada.

TABLE 2: ACTIVE APPLIED RESEARCH PROGRAM (ARP) PROJECTS FOR FISCAL YEAR 2003–2004

CLIENT GROUP	THRUST / PROJECT NAME	DATES		CONTRACT R&D		ALL RESOURCES[1]	
		Start	End	Total ($000)	FY 03/04 ($000)	Total ($000)	FY 03/04 ($000)
Maritime	**Maritime Integrated Above Water Warfare (AWW)**						
	Defensive Aids Suites for Shipboard AWW	2002	2006	2,399	399	6,599	1,516
	Measurement and Modelling for Integrated Signature Management	2002	2006	1,356	205	3,702	682
	Sensor Modelling, Assessment and Development for Ship Self-Defence	2002	2007	4,047	710	11,328	1,973
	Net-Centric Concepts for Multi-Platform Maritime AWW Operations	2002	2007	1,146	275	3,697	652
	Maritime Command, Control, Communications and Intelligence						
	Combat System Resource Management	2002	2006	1,359	328	4,074	690
	Situation Analysis Support Systems for the HALIFAX Class	2002	2006	2,200	550	5,693	1,351
	Task Group Maritime Tactical Picture Compilation	2002	2006	1,148	300	3,497	964
	Virtual Ship Combat System	2002	2006	1,056	250	4,381	1,348
	Command Advisory System	2002	2006	2,025	425	4,309	1,067
	Maritime Underwater Warfare						
	Deployable and Fixed Sensor Systems for Littoral Underwater Warfare	2002	2004	1,343	322	3,751	1,048
	Torpedo Detection, Classification and Localization and Countermeasures	2002	2005	406	147	1,965	650
	Naval Platform Target Strength Prediction, Measurement and Modification	2002	2007	2,307	527	9,691	2,705
	Task Group Mine Defence Concept Development	2002	2007	2,387	467	7,362	1,542
	Technology Evaluation for Rapid Environmental Assessment	2002	2007	2,857	247	14,152	1,277
	Multi-Static ASW with Deployable Sources	2002	2007	3,709	755	16,084	1,863
	UWW Miscellaneous Activities	2003	on-going	787	123	2,331	374
	Naval Platform Technology						
	Ship Structures	1996	2004	1,897	8	7,895	43
	VICTORIA Class and UMV Platform Technology	2001	2005	936	310	3,075	1,097
	Emerging Materials for Maritime Applications	2001	2005	3,189	209	8,092	1,750
	Modelling and Simulation of Surface Ship Platform Systems	2001	2006	2,031	449	9,501	2,000
	Rational Maintenance and Evaluation Protocols for Naval Platforms	2001	2006	2,062	571	5,759	1,414
	Maritime Intelligence, Surveillance and Reconnaissance (ISR)						
	Integrated Multi-Sensor Multi-Environmental Ocean Surveillance System	2000	2005	1,185	270	2,220	787
	Data Fusion and Decision Support for Maritime ISR	2003	2006	917	182	4,879	634
Land	**Command**						
	Advanced Planning Solutions for Land Tactical Command and Control Systems	1998	2005	2,085	285	4,428	394
	Sense						
	Autonomous Land Systems	2000	2005	3,385	440	14,200	3,971
	Ground Target Surveillance with Multi-Sensor Fusion	2000	2006	2,420	180	5,046	387
	Systems for Urban Operations	2001	2005	2,441	680	6,075	2,040
	Distributed Communications Electronic Warfare	2003	2006	1,680	496	3,361	914

[1] "All Resources" includes contracted research and development, external cash, in-kind contributions, and full costs of DRDC's science and technology workers.

TABLE 2: continued

CLIENT GROUP	THRUST / PROJECT NAME	DATES		CONTRACT R&D		ALL RESOURCES	
		Start	End	Total ($000)	FY 03/04 ($000)	Total ($000)	FY 03/04 ($000)
Land	**Act**						
	Future Large Calibre Ammunition Concepts	2001	2008	3,430	490	7,088	678
	Act Supplementary Studies	2001	on-going	1,386	0	4,120	12
	Energy Release Research	2002	2008	3,034	200	6,945	537
	Shield						
	Advanced Hand-Held Mine Detection	1995	2005	1,611	245	4,335	616
	Protection of LAV Occupants Against Blast Landmines	1999	2004	2,585	410	5,730	1,096
	Investigation of Advanced Protection Systems for LAVs	1999	2004	2,020	375	4,896	1,348
	Defensive Aid Suites	1999	2004	2,511	486	4,431	1,260
	Soldier Protection Against Blast Weapons	2002	2008	2,040	405	6,411	1,570
	Sustain						
	Modelling of Soldier Performance Enhancement and Degradation	2000	2005	1,387	278	2,175	594
	Army CCIS Development and Training Through Simulation	2000	2005	1,741	250	3,615	523
	Vetronics	2001	2005	550	170	1,411	381
	Land Munitions Life Cycle Sustainment	2002	2005	788	342	6,924	1,755
	Sustainability in Cold Conditions	2003	2006	2,590	295	4,434	898
Air	**Air Force C2ISR**						
	Search and Rescue Operations	1998	2004	3,924	600	5,832	1,222
	Area Surveillance	1998	2004	5,041	680	13,466	1,780
	Mission Safe Conduct	1998	2004	1,488	280	3,532	622
	Combat Surveillance	1998	2004	1,653	190	5,976	1,041
	Situation Assessment/Information Fusion	2000	2004	944	169	1,835	337
	Mission Planning	2000	2004	2,345	490	6,624	1,381
	Air Combat Systems						
	Self-Defence Against Multi-Spectral Threat	2001	2005	1,808	472	3,654	1,247
	Air Weapons Engagement	2001	2006	869	225	3,930	1,267
	Standoff Precision Strike	2001	2006	2,805	635	9,658	2,926
	Aircraft Protection Against ManPADS	2002	2005	1,492	450	5,025	1,793
	Future Network-Centric RF EWS	2002	2007	1,319	75	1,683	104
	Synthetic Air Weapons Range	2003	2006	410	135	770	187
	Advanced Software-Based Electronic Support System	2003	2007	945	75	5,061	254
	Air Vehicle Systems						
	Aeropropulsion/Gas Turbine Technologies	1998	2004	4,436	279	8,554	695
	Aircraft Structures and Materials	1998	2004	6,196	595	9,869	2,169
	Aerodynamics Research	1998	2004	3,950	70	8,050	3,124
	Advanced Power Sources	1998	2004	1,129	264	2,177	511
	Flight Mechanics	1998	2004	1,300	0	2,319	906
	Advanced Portable Fuel Cell	2000	2004	800	200	1,791	697

TABLE 2: continued

CLIENT GROUP	THRUST / PROJECT NAME	DATES		CONTRACT R&D		ALL RESOURCES	
		Start	End	Total ($000)	FY 03/04 ($000)	Total ($000)	FY 03/04 ($000)
Air	**The Human in Air Systems**						
	Cockpit Systems Integration	1999	2004	3,078	701	3,259	744
	Advanced Cockpit Interface Technologies	1999	2004	1,531	200	1,618	200
	Disorientation Countermeasures	1999	2004	802	119	2,232	345
	Aircrew Performance	1999	2004	239	50	239	50
	Advanced Aircrew Anti-G Systems	1999	2005	2,252	322	5,937	1,385
	Aircrew Life Support Equipment	1999	2005	492	141	6,261	903
	Adaptive, Intelligent Aviation Interfaces	2003	2006	900	300	1,727	569
	Air Mission Systems						
	Air Force Mission Systems – General	2003	on-going	1,524	150	2,643	193
Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR)	**Command and Control/Information and Intelligence**						
	Technologies for the Synthesis of a Common Operational Picture	1997	2005	1,135	170	2,255	305
	Coalition Interoperability	2000	2006	868	153	2,089	417
	Geospatial Technologies for Information Decisions (GEO-TIDE)	2000	2006	1,461	311	3,206	592
	Other Applications of HFSWR	2002	2006	1,369	315	2,622	706
	Knowledge Management	2002	2006	894	351	2,896	788
	Information Operations						
	High-Fidelity ESM and ECM Techniques	1998	2004	1,947	555	4,878	1,531
	ESM Capability for CDMA Signals	1998	2004	3,070	338	4,199	852
	Countermeasures to Novel Electromagnetic Threats	1998	2005	3,306	344	7,342	1,301
	Real-Time Net IO for Co-Operative Operations	1998	2005	12,526	1,782	24,065	4,062
	Navigation Warfare	1999	2004	874	244	1,567	664
	Military Information Technology Infrastructure						
	A Low-Cost Phased Array Antenna Module for EHF SATCOM Terminals	2001	2005	1,166	123	3,533	123
	Coalition Networks	2001	2005	1,298	405	6,314	512
	High Performance Wireless Communications	2001	2005	747	231	3,745	231
	Naval Communications Infrastructure	2001	2005	1,060	300	4,378	431
	Support to DND SATCOM Infrastructure	2001	2010	123	36	3,553	607
	Space Systems and Technology for Defence Applications						
	Platform Reduction for Future Space-Based Radar	2002	2005	801	335	2,555	930
	Maximize Imagery Analysts' Productivity	2002	2005	2,341	400	12,881	2,135
	Development of HS, IR and EO Imagery Exploitation Applications	2002	2005	1,212	326	5,852	1,655
	Space Technology Initiatives for Improved Performance	2002	2005	1,263	195	4,382	992
	Operational Impact of Space-Based Wide-Area Surveillance Capability	2002	2006	2,055	350	8,323	2,140
	Surveillance of Space Insertion	2002	2006	1,952	420	5,161	936

TABLE 2: continued

CLIENT GROUP	THRUST / PROJECT NAME	DATES		CONTRACT R&D		ALL RESOURCES	
		Start	End	Total ($000)	FY 03/04 ($000)	Total ($000)	FY 03/04 ($000)
Human Performance (HP)	**Simulator Training Technologies**						
	Training Devices	1998	2006	1,870	294	4,374	801
	Collective Networked Simulation	1999	2009	1,719	330	10,462	516
	Instructional Methods	1999	2005	737	0	2,892	50
	Representation of Human Behaviour	2001	2005	370	150	1,177	368
	Military Operational Medicine						
	Deployment Readiness	1998	2005	896	275	1,202	422
	Combat Casualty Care	1999	2005	5,783	420	9,059	905
	Operational Health Hazards	1999	2005	1,516	335	6,267	1,680
	Field Medical Technology	1999	2007	1,210	170	2,403	264
	Diving and Underwater Intervention						
	Undersea and Hyperbaric Life Support and Safety	2003	2007	1,003	180	7,636	743
	Undersea and Hyperbaric Work Support and Safety	2003	2007	720	144	4,028	418
	Human Factors In Military Systems						
	Human Engineering Performance Modelling Environment	1998	2005	907	0	2,907	30
	Human-Computer Interaction	1998	2005	1,641	45	3,090	387
	Human System Integration Tools	1998	2005	1,466	290	2,491	487
	Framing Command Concepts	2001	2005	606	317	1,858	670
	Decision Rules in C2 Situations	2003	2007	1,013	85	4,990	797
	Psychological Adaptation 1	2003	2007	420	160	3,146	714
	Defence Against Chemical, Biological, and Radiation Hazards						
	Defence Against Radiological Hazards	1997	2007	3,040	430	6,712	993
	Agents of Immediate Operational Impact	1998	2007	12,001	955	39,082	3,912
	Prevention and Treatment of Injury and Disease	1998	2008	14,580	1,045	37,551	4,012
	Militarized CATSI – EDM	2003	2008	0	0	1,374	58
TOTAL				**227,075**	**35,233**	**631,874**	**113,135**

TABLE 3: ACTIVE TECHNOLOGY DEMONSTRATION PROGRAM (TDP) PROJECTS FOR FISCAL YEAR 2003–2004

CLIENT GROUP	THRUST / PROJECT NAME	DATES		CONTRACT R&D		ALL RESOURCES[2]	
		Start	End	Total ($000)	FY 03/04 ($000)	Total ($000)	FY 03/04 ($000)
Maritime	**Maritime Integrated Above Water Warfare**						
	Shipboard Integration of Sensor and Weapon Systems	2000	2006	6,000	2,890	9,520	3,686
	Maritime Command, Control, Communications and Intelligence						
	SHINCOM Upgrade	1996	2003	10,100	40	16,550	153
	Command Decision Aids Technology	2000	2004	5,606	834	8,598	1,581
	Force Threat Evaluation Weapons Assignment	2003	2008	7,600	161	10,740	583
	Maritime Underwater Warfare						
	Towed Integrated Active/Passive Sonar	1997	2005	16,172	1,403	22,707	3,330
	Remote Minehunting System	1997	2003	9,004	70	10,223	311
	Networked Underwater Warfare	2001	2006	6,200	701	16,907	1,564
	Naval Platform Technology						
	Improved Ship Structural Maintenance Management	1996	2005	4,955	594	6,667	998
	Maritime Intelligence, Surveillance and Reconnaissance						
	Rapidly Deployable Underwater Acoustic Surveillance System	2000	2006	7,500	1,116	14,981	2,604
	Multi-Sensor Integration Within Common Operating Environment	2002	2007	6,000	602	9,603	1,055
Land	**Command**						
	Tactical High Capacity Communication Links	2000	2006	5,600	1,274	11,174	2,819
	Sense						
	Soldier Information Requirements	1996	2005	11,500	1,157	15,306	1,949
	Intelligence, Surveillance, Target Acquisition and Reconnaissance	2000	2006	7,900	2,762	16,162	4,635
	Integrated Communications EW Analysis and RF Sensor	2002	2007	5,700	1,052	12,507	2,322
	Advanced Linked Extended Reconnaissance and Targeting	2003	2008	5,950	250	9,973	624
	Act						
	Future Armoured Vehicle Systems	2000	2005	8,750	942	14,141	2,731
	High Energy Missiles for Light Combat Vehicle	2000	2006	7,100	2,001	20,127	4,068
	Soldier Integrated Headwear System	2002	2006	5,800	350	9,482	1,107
	Multi-Mission Effects Vehicle	2003	2006	7,255	1,800	10,223	2,374
	Shield						
	Force Protection Against Enhanced Blast Weapons	2002	2007	5,930	1,381	16,941	2,992
Air	**Air Force C2ISR**						
	Hyperspectral Imagery for Improved Airborne Intelligence, Surveillance and Reconnaissance	2000	2005	5,911	1,456	7,440	1,817
	Maritime Air Littoral Operations	2000	2006	6,200	316	9,698	857
	Uninhabited Surveillance Vehicle	2001	2004	685	250	3,473	472
	Air Combat Systems						
	Tactical Aviation Mission System Simulation	1999	2004	6,140	1,030	7,426	1,158

[2] "All Resources" includes contracted research and development, external cash, in-kind contributions, and full costs of DRDC's science and technology workers.

TABLE 3: continued

CLIENT GROUP	THRUST / PROJECT NAME	DATES		CONTRACT R&D		ALL RESOURCES	
		Start	End	Total ($000)	FY 03/04 ($000)	Total ($000)	FY 03/04 ($000)
Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C4ISR)	**Command and Control/Information and Intelligence**						
	High Frequency Surface Wave Radar for Coastal Surveillance	1995	2004	8,111	7	9,646	7
	Common Operating Picture 21	1999	2005	6,120	1,844	15,405	4,484
	Coalition Aerial Surveillance and Reconnaissance	2001	2005	1,241	291	3,838	752
	Collaborative Capability Definition Engineering and Management	2002	2007	7,411	2,533	16,881	5,576
	Joint Command Decision Support 21	2003	2008	6,000	163	8,725	465
	Information Operations						
	Joint Network Defence and Management Systems	2003	2008	5,250	157	6,452	478
	Military Information Technology Infrastructure						
	Advanced SATCOM Terminal	2001	2006	2,650	78	11,476	1,489
	Space Systems and Technology for Defence Applications						
	Radarsat 2 GMTI	1999	2008	9,226	682	29,914	1,881
	High Earth Orbit Space Surveillance	2003	2007	6,500	20	13,242	284
Human Performance (HP)	**Simulator Training Technologies**						
	Advanced Distributed Mission Training	1999	2004	7,452	1,201	7,976	1,411
	Advanced Deployable Day/Night Simulation	2003	2008	6,500	205	8,173	895
	Defence Against Chemical, Biological, and Radiation Hazards						
	Vaccine Development Initiative	1998	2005	5,613	897	7,503	1,107
	CB Combat Duty Uniform (CB Plus)	2001	2006	5,900	905	10,748	1,486
	Aerosol Inhalers for Field Prophylaxis and Therapy (Cipro Plus)	2001	2006	4,000	13	8,982	167
TOTAL				**251,531**	**33,424**	**449,529**	**66,274**

TABLE 4: ACTIVE TECHNOLOGY INVESTMENT FUND (TIF) PROJECTS FOR FISCAL YEAR 2003–2004

CLIENT GROUP	THRUST / PROJECT NAME	DATES		CONTRACT R&D		ALL RESOURCES[3]	
		Start	End	Total ($000)	FY 03/04 ($000)	Total ($000)	FY 03/04 ($000)
Maritime	**Maritime Integrated Above Water Warfare (AWW)**						
	Synthetic Target Signature Generation for Non-cooperative Target Recognition	2002	2005	750	200	1,080	288
	Adaptive Learning Techniques for Future Radar and Communications ESM	2002	2004	750	250	975	325
	Application of Evolutionary Algorithms to the Optimization of an Adaptive Control System for Closed-Loop ECM systems	2003	2006	750	239	1,140	363
	Maritime Command, Control, Communications and Intelligence						
	Decision-Centred Evaluation Capability (DCEC) of Decision Support Systems from a Net Decision-Making and an Operational Perspective	2003	2006	750	230	1,240	380
	Maritime Underwater Warfare						
	Aural Discrimination of True Targets from Geological Clutter	2003	2006	750	150	1,485	297
	Naval Platform Technology						
	Fabrication of Organic Radar Absorbing Material	2001	2004	750	250	1,091	364
	Dielectric Actuators for Active/Passive Vibration Isolation	2002	2005	750	310	1,165	482
	Design of Magnetic Shape Memory Alloys	2002	2005	750	245	1,703	556
Land	**Sense**						
	Volumetric Sensing of Complex Environments for Control of Complex Vehicles	2003	2005	700	250	1,778	635
	Act						
	Development of Polymer Coating	2002	2005	625	225	1,090	392
	Sustain						
	Advanced Electrochromic Polymer Technologies for Adaptive Camouflage Applications	2003	2006	545	175	945	303
Air	**Air Force C2ISR**						
	Active Identification System for Unresolved Airborne Targets	2001	2005	750	142	1,295	245
	Novel NIR Imaging Sensors	2001	2004	510	180	1,971	696
	CoA Critiquing System for the Improvement of the Military Estimate Process	2002	2004	750	145	1,050	203
	Low Probability of Intercept Synthetic Aperture Radar (LPISAR)	2003	2004	650	100	875	135
	Air Combat Systems						
	Supersonic Missile Flight Control	2003	2006	750	259	1,982	684
	Air Vehicle Systems						
	Modelling Crystal Superalloy Properties from First Principles	2001	2004	300	100	588	196
	Smart Materials System Development and Test	2002	2005	289	93	623	200
	Space Systems and Technology for Defence Applications						
	Bistatic STAP Signal Processing for Space-Based Radar	2002	2004	300	50	521	87
	Polarimetric InSAR	2002	2004	725	120	908	150
	Advanced RF Tag for SAR	2002	2004	750	288	1,050	403
	Nanotechnologies in Military Systems	2002	2004	750	225	985	296

[3] "All Resources" includes contracted research and development, external cash and in-kind contributions.

TABLE 4: continued

CLIENT GROUP	THRUST / PROJECT NAME	DATES		CONTRACT R&D		ALL RESOURCES	
		Start	End	Total ($000)	FY 03/04 ($000)	Total ($000)	FY 03/04 ($000)
Human Performance	**Military Operational Medicine**						
	Ultrasonic Sensing and Imaging Technology Applied to Field Medicine Diagnostics	2000	2003	750	258	1,219	419
	Emerging Material Technologies for Applications in Battlefield Wound Care	2003	2005	505	260	757	390
	Human Factors In Military Systems						
	Display Techniques for Improving Battlespace Visualization	2001	2004	750	163	988	215
	Adaptive and Creative Decision-Making Under Stress	2003	2006	750	250	1,161	387
	Defence Against Chemical, Biological, and Radiation Hazards						
	Molecular Target Identification for Novel Antimicrobial Development	2001	2004	950	340	1,530	548
	Nanostructured Metal-Organic Polymers for CB Protective Barriers	2001	2004	562	188	749	251
	Nucleic Acid-Based Drugs Against BW Agents	2003	2006	750	250	1,950	650
TOTAL				**19,411**	**5,934**	**33,894**	**10,538**

TABLE 5: ACTIVE DEFENCE INDUSTRIAL RESEARCH (DIR) PROGRAM PROJECTS FOR FISCAL YEAR 2003–2004

CLIENT GROUP	THRUST / PROJECT NAME	DATES		CONTRACT R&D		ALL RESOURCES[4]	
		Start	End	Total ($000)	FY 03/04 ($000)	Total ($000)	FY 03/04 ($000)
Maritime	**Maritime Underwater Warfare**						
	Processing of Biased PZT Material for Use in High-Power Sonar Transducers and High-Strain Actuators	2002	2004	500	172	1,424	542
Land	**Command**						
	Software Defined Radio VHF Transmitter / Receiver	2003	2004	500	174	1,368	724
	Sense						
	Tri-Dimensional Automatic Target Recognition	2002	2004	325	74	1,001	304
	Act						
	Fuse Setting Technologies Assessment and Analysis	2001	2004	500	232	1,000	465
	Hydro-Reactive Gas Generator Hybrid (HyPerG)	2001	2004	199	109	654	358
	Advanced Packetized Oxidizers for High Performance Missiles	2001	2004	127	52	424	137
	Launch and Flight Characteristics of Kinetic Energy Projectiles	2002	2006	401	264	802	319
	Novel Thermal Weapon Sight	2003	2004	262	175	578	375
	Research Study on the Pyrotechnic Applications of Nanometric Formulation	2003	2006	287	142	574	283
	Shield						
	Ultra-Light Ceramor Bullet Resistant Plates for Personal Protection	2003	2004	400	200	1,222	617
	Near Net-Shape Forming of a Lightweight Torso Protection Plate	2003	2004	1,029	733	1,029	733
	Recombinant Spider Silk-Based Advanced Performance Fibre	2003	2005	500	250	2,511	1,251
	Sustain						
	Display Assessment and Enabling Technology Research for New Military Displays	2000	2004	500	86	986	170
Air	**Air Force C2ISR**						
	Multi-Platform Data Fusion Between Halifax Class Frigate and an Airborne Collaborating Platform	2001	2003	500	6	1,397	41
	Data Mining for Decision Support Systems	2002	2004	500	279	1,000	537
	Air Vehicle Systems						
	Improved Oil Debris Monitor	2001	2004	266	138	820	414
	Development of Gas Turbine Life Prediction Software	2002	2006	500	230	1,063	394
	Development of a Prototype Alternating Current Potential Difference System	1999	2005	363	100	726	200
	Development of Advanced Navier-Stokes Methods For Vortical and Separated Flows	1999	2004	500	73	1,473	224
	Time Domain Aeroservoelastic Research	2004	2007	315	9	630	18

[4] "All Resources" includes contracted research and development, external cash and in-kind contributions.

TABLE 5: continued

CLIENT GROUP	THRUST / PROJECT NAME	DATES		CONTRACT R&D		ALL RESOURCES	
		Start	End	Total ($000)	FY 03/04 ($000)	Total ($000)	FY 03/04 ($000)
C4ISR	**Command and Control/Information and Intelligence**						
	UAV Engineering Study	2002	2003	500	14	1,316	73
	Information Operations						
	Secure Internet Communication Using 7NET Technology	2002	2003	500	231	1,105	406
	Military Information Technology Infrastructure						
	Single-Chip MEMS Switch Networks	2001	2004	500	21	1,000	48
	Space Systems and Technology for Defence Applications						
	Near Earth Space Surveillance	2002	2003	99	96	679	248
	SatPose-Estimating Satellite Orientation and Configuration	2003	2004	302	179	604	358
	Algorithms for HS Target Detection	2002	2003	491	92	982	249
Human Performance	**Military Operational Medicine**						
	Hemoglobin-Starch Conjugates for Blood Volume Replacement and Oxygen Delivery	2000	2004	500	296	1,007	245
	Human Factors in Military Systems						
	Case-Based Reasoning on Aircraft Technician Fault Diagnostic Learning and Learning Retention	2002	2005	472	335	1,903	810
	Safework DIR Integrated IPME/SAFEWORK Graphical Human Task Environment (INSIGHT)	2002	2005	474	161	952	361
	Defence Against Chemical, Biological and Radiation Hazards						
	Immune Modulator Strategy, Phase III	2001	2003	496	93	992	138
	An Innovative Approach for the Management of Anthrax and Brucella Infections	2003	2005	495	242	990	485
TOTAL				13,302	5,257	32,211	11,528

TABLE 6: ACTIVE PROJECTS THAT PROVIDE ADVICE ON SCIENCE AND TECHNOLOGY FOR FISCAL YEAR 2003–2004

THRUST / PROJECT NAME	CONTRACT R&D FY 03/04 ($000)	ALL RESOURCES[5] FY 03/04 ($000)
Technology Outlook		
Symposia/Workshops on Emerging Issues	45	216
Rapid Expert Assessment of Emerging Technologies	165	431
Influencing Departmental and National S&T Policy	92	986
Technology Foresight	136	455
Methods for Capturing and Using S&T Knowledge to Advance Defence Strategy 2020	30	95
Communication of Emerging Issues	2	76
International Collaboration	32	294
Scientific and Technical Intelligence Support and Advice (STISA)		
STISA – Weapons	1,003	2,115
STISA – Chemical and Biological Defence	67	256
STISA – Command, Control and Information Systems	230	423
STISA – Other Systems and Devices	100	251
Scientific and Technical Services for Operations (STO)		
Specialist STO Support to CG1 – Maritime	8	70
Specialist STO Support to CG2 – Land	0	28
Specialist STO Support to CG3 – Air	0	185
Specialist STO Support to CG5 – C4ISR	0	11
Specialist STO Support to CG6 – HP	149	449
Specialist STO Support to NDHQ	0	22
Medical Assessment and Training	0	132
Support to CF Diving	0	31
Marine Materials Support	0	1,619
Support to Joint Exercises/Experiments	0	333
Support to Major CF Operations – Domestic and International	6	6
Operational Research		
Maritime Operational Research	0	1,879
Land Operational Research	0	1,854
Air Operational Research	0	1,695
DCDS Operational Research	0	2,230
VCDS Operational Research	0	1,891
ADM(S&T) Operational Research	0	1,502
ADM(Mat) Operational Research	0	580
ADM(HR Civ/Mil) Operational Research	0	3,089
Intelligence – DSI	0	2,428
CORT Operational Research	0	412
TOTAL	**2,065**	**26,043**

[5] "All Resources" includes contracted research and development, and full costs of DRDC's science and technology workers.

TABLE 7: PATENTS GRANTED

The following patents were granted to DRDC during fiscal year 2003–2004:

- Method for Tracing Organ Motion and Removing Artifacts for Computed Tomography Imaging Systems
- Axial Drive Resonant Pipe Projector
- Non-Invasive 3-D Intracranial Thermography System
- Insensitive Melt Cast Explosive Compositions Containing Energetic Thermoplastic Elastomers
- Flared Wave-Guide Projector
- Flextensional Resonant Pipe Projector
- Energetic Copolyurethane Thermoplastic Elastomer
- Multi-Mode Pipe Projector
- Combination Vaccine for Enhancing Immunity Against Brucellosis
- Nozzles for Pyrophoric IR Decoy Flares
- Articulated Robotic Scanner for Mine Detection
- Wide-Area Coverage Infrared Search System
- Broad-Spectrum Decontamination Formulation and Method of Use
- In-service Detection of Corrosion in Multi-Layer Structure Using the Lift-Off Point of Intersection
- Miniature Stimulated Raman Shifting Cell

Contact Information

DRDC publishes this report annually to describe its operations for the previous fiscal year, and includes information about DRDC's performance with respect to the objectives established in its business plan, its financial performance, and any other information that the Deputy Minister of National Defence may require to be included.

Reports like this one should meet audience expectations. Our goal is to ensure that this report can readily serve as a quick and easy reference, personal or professional, to keep you up to date on what DRDC and, by extension, Canada is doing in the area of defence R&D. We invite you to get in touch with us should you have any suggestions or questions.

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